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Tractors and Implements

WORLD CROPS

The International Journal of Agriculture

VOLUME 13, No. 10 OCTOBER 1961

SEVIN insecticide is helping to increase yields of maize in Egypt. For further details, see page 372

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WORLD CROPS

The International Journal of Agriculture

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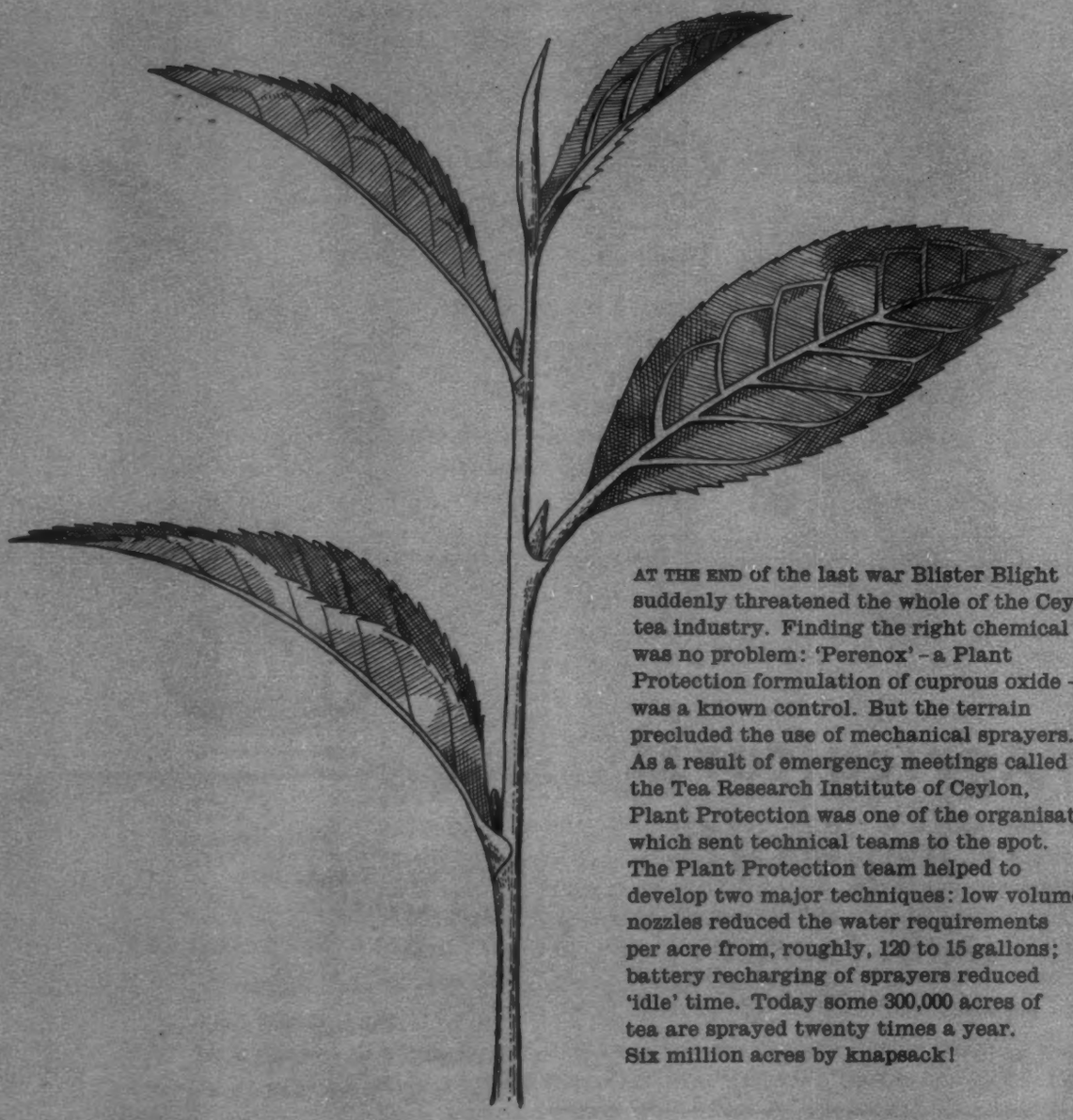

AT THE END of the last war Blister Blight suddenly threatened the whole of the Ceylon tea industry. Finding the right chemical was no problem: 'Perenox' – a Plant Protection formulation of cuprous oxide – was a known control. But the terrain precluded the use of mechanical sprayers. As a result of emergency meetings called by the Tea Research Institute of Ceylon, Plant Protection was one of the organisations which sent technical teams to the spot. The Plant Protection team helped to develop two major techniques: low volume nozzles reduced the water requirements per acre from, roughly, 120 to 15 gallons; battery recharging of sprayers reduced 'idle' time. Today some 300,000 acres of tea are sprayed twenty times a year. Six million acres by knapsack!

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Editorial Comment

Power for the Land

THE DEVELOPMENT OF the internal combustion engine has had a greater influence on farming than any other single factor during the last 50 years. Farming is, indeed, largely a matter of applying power to the land, whether by man, by work animals or by tractors.

It all began in 1794, when an English inventor named Street first proposed the use of oil to produce motive power, though the first practical oil engine was that of Julius Hock, of Vienna, in 1870. His machine was very cumbersome and produced very little power and it was followed in 1873, *i.e.* less than 100 years ago, by the first really effective compression engine using oil. This was the invention of another Englishman, living in America, named Brayton.

Of course, steam had some influence on agriculture, but steam engines were costly and cumbersome, and they soon gave place to the oil engine. The internal combustion engine has made it possible to take power almost anywhere and to carry out farming operations, land reclamation schemes and irrigation projects, which were impossible in the days of mamottis, shovels, baskets, wheelbarrows, buffaloes and horses.

In assessing the effect of the introduction of the internal combustion engine into agriculture, it is common to emphasise—for or against—only the reduction in man-power. It has been estimated, for instance, that one man driving a small tractor can do as much work as 200 men working with hand tools and five times as much as one man with a team of horses.

To give another illustration: 100 years ago it took eight men to scythe an acre of cereals in a day; now eight men on combine harvesters with attendant trailers can harvest and thresh nearly 200 acres in one day.

The more efficient economy through the machine does not end there. As more machines are employed, so fewer farm animals will be needed and more land is thereby released for food production, *i.e.* the land that would otherwise be used to produce grass, oats or oil cakes for the maintenance of the animals. Otherwise expressed, it requires three acres of land to feed a horse.

Tractors and Manure

It is often argued that the tractor does not produce any manure. This is a challenge which has to be answered, even though in India cow dung is still being used as fuel on a vast scale, and this is one of the principal causes of the low fertility of Indian soils. In Britain, too, cow manure is commonly described as a nuisance and an embarassment because of its enormous bulk in relation to its manurial value.

The answer lies in the efficient use of fertilisers and the turning in of all plant residues with mechanical implements which were not previously available. Although the scientist has by no means reached finality in the field of plant nutrition, he has gone a long way in the last 50 years and farmyard manure is no longer regarded as an indispensable element in good farming. If it is readily available and can be cheaply applied, well and good; but if not, it is just as effective to apply fertilisers, if the correct mixture required by the crop and the soil is known. So the fact that the tractor does not produce manure can be an advantage.

Power and the Future

While the population problem is the gravest issue we have to face, little or nothing is being done about it. Every year a population equal to that of France is being added to the numbers that must be fed.

The future of our civilisation depends on our ability to apply more power and still more power to the land so as to improve yields on the better lands and make the second-class lands more productive; to open up more land, to reclaim the fringes of the deserts, to drain swamps and desalinate sea marshes, and to isolate by sea walls shallow areas at present under the sea and convert them for food production. In effect, we are beginning 'to scrape the barrel'.

Meanwhile the visionaries, almost entirely without justification, are suggesting that the future lies in emigration to other planets. Prof. Sir Bernard Lovell has even been credited with saying that ' . . . the advance of Soviet science and technology . . . was an important step in the Russian plan to populate the solar system, beginning with the invasion of the moon in a few years' time'. He has the saving grace to add 'assuming that the astronaut did not suffer any unforeseen effects from his exposure in outer space'.

We submit that the future does not depend on wasting in prodigal fashion our power resources on accelerated and unrelated programmes of space research which will do nothing towards the solution of our population problems. As things are, few countries show any tendency to make room for the unborn, and some are getting ready to send a human tide into neighbouring countries and establish new imperialisms to replace the old.

To present the population problem in its harshest reality, the problem by 1980 will be to transport one thousand million people to another planet, even assuming there is another planet fit to inhabit and there are sufficient starry-eyed people who want to inhabit the mountains of the moon. Moving this vast number of people from one country to another on this

planet would present a major problem of colonisation, but a thousand million to another planet . . .

We need to keep clearly in mind what our objective is. So many countries are going wrong through trying to solve several problems at the same time. The real purpose of farming today must be to produce *more food where it is most needed*, not the establishment of new social systems, or the creation of employment. It may not even be essential to produce food at a profit, for it may be sounder policy to produce more food at a loss concealed by a system of subsidies.

Tractors . . .

Tractors are very variable in size and power, for they range from enormous machines of over 100 h.p. and weighing several tons to very small single-wheeled machines of under 1 h.p.

There is no need to talk of the possibility of another world slump while, for instance, India has only one tractor for every 20,000 acres and England has one for every 25 acres. Once upon a time agriculture could be described as the most depressed and unprogressive industry in Britain. We have solved the problem by the system of agricultural subsidies, and so, too, can other countries by giving top priority for agriculture.

Britain today leads the world in tractor exports and in the first half of this year they were £700,000 more than in the corresponding period of 1960, when the total value of exports reached a record of over £86 million. Here is a picture of progress:

Tractor Production and Exports

	Output	*Exports*
1956 ..	139,000	92,000
1957 ..	185,000	115,000
1958 ..	187,000	106,000
1959 ..	216,000	116,000
1960 ..	231,000	146,000

. . . And Implements

More and more agricultural implements to be seen at the agricultural shows each year illustrate the trend of modern farming in the more advanced countries, but what of the less developed, the under-developed and the downright backward countries?

These countries have still to learn that neither men, nor horses, nor buffaloes can do the work of the bull-dozer, the land planer, the subsoiler, the multiple plough, the mechanical plough and the tractor-powered rainer, which together have contributed so much to America's over-production, while other countries still depend on the mamotti and the buffalo plough and can no longer produce enough for their peoples.

With relays of drivers, also, it is possible for a tractor to work continuously with only minor stops for maintenance and refuelling (see WORLD CROPS, 1961, **13**, 257), so that food production plans can be carried through to a successful conclusion in spite of the hazards of the weather. Such non-stop operation is not possible with animal power.

There is so much to be done and so little time to do it in. As the world's population grows, so the world's poverty grows also. The cry is for more and still more international credits, but these alone can be no substitute for hard work and initiative by the peoples of the under-developed countries and for business to pass they must convince manufacturers of their commercial integrity and economic stability.

Problem of Surpluses

UNDER THE TITLE 'Food for Peace', Dr. Joseph S. Davis contributes a forthright article in *Food Research Institute** on the policy of the U.S.A. regarding farm support, acreage allotment, surplus acquisition and surplus disposal. We are not concerned with the internal policies of American agriculture, so pungently criticised in this article, beyond noting that, in the author's opinion, surpluses have helped to tighten the grip on the U.S.A. of an obsolete and costly programme and have complicated relations with Canada and other wheat-producing nations whose friendship is vital to America.

The policy fails, he claims, because the more surpluses disposed of at home and abroad the greater the incentive to production of even larger surpluses. This view is, indeed, supported by FAO's Committee on Commodity Policy, which reported in 1959:

'. . . as a broad generalisation it may be said that the movement of agricultural surpluses into export, whether by concessional sales, barter, or donations, has not prevented the further generation of surpluses. Indeed, the general effect may have been to delay actions that might reduce surpluses. If embarrassingly large stocks are reduced through disposals abroad, pressures to correct the generation of surpluses will be less'.

Aid for Needy Countries

It seems unfortunate that the embarrassment of the U.S.A. in coping with the situation created by their farm policy should be coupled with the help that country has given since the war to meet serious world food shortages and numerous threats of famine, for the Americans have evinced deep concern over poverty and hunger; they have given generously to combat disease and to provide technical aid through international organisations. They have endeavoured to transform their burden of surplus foodstuffs into a blessing by making them available where they were most needed.

There appears, however, to be some doubt about the extent of world hunger or subnormal nutrition. Falling mortality rates and population upsurges rather belie the impression that starvation is either common or chronic. After long study of reliable dietary surveys the Food Research Institute's conclusion is:

'. . . that chronic marked undernutrition, with associated adverse

* Vol. 1, No. 2, May 1960. Published by Stanford University Food Research Institute. Price $2.50 or $7.00 per year.

health symptoms, is rarely encountered as a characteristic of large population groups—that it is mainly to be found among widely scattered, unrepresentative individuals (probably predominantly located in large cities) and small, unrepresentative, primitive groups'.

The Long View

It is now felt that instead of making lavish gifts of foodstuffs the best way of helping under-developed countries to overcome their nutrition problems is to assist them in raising their levels of food consumption and living by building up their own agriculture and so developing balanced economies. Needy countries must realise that the achievement of these objectives ultimately depends on their own efforts.

The conclusion is reached that, while surplus food disposals have met many major and minor food emergencies and generally yielded valuable results, they have also encountered limiting factors and show no promise of permanently eliminating hunger of malnutrition where these are chronic. The long-term challenge can be met only by helping low-income countries to realise their productive potentials.

War on Want

IN THE WAR ON WANT, which will intensify as world population continues to grow the Young Farmers of today have an important part to play in preparing themselves to be the progressive farmers of tomorrow. Welcoming 86 of them from 12* different countries at the Royal Show at Cambridge, Mr. W. B. Batty, general manager of the Tractor Group of the Ford Motor Co. Ltd., said that upon the production and distribution of food depends, primarily, the whole trend of political feeling in the world.

In this cause the manufacturers of the basic motive power behind modern farming—the tractor—were with them, and he considered that it was the clear duty of the large commercial organisations connected with agriculture to foster exchange visits between young farmers of different countries and so help to develop and expand the Young Farmer movement as a world force to be reckoned with.

Through their common interest in a prosperous world agriculture there was a great chance to break through national and political barriers and clear away the prejudices and misunderstandings of the past. Who, he asked, was better equipped than the Young Farmer of today to undertake this task. He had met and studied many Young Farmer delegations from many countries and he had noted one outstanding characteristic of these men and women—they were all pleasant, fluent and purposeful ambassadors for the countries they represented and, indeed, were a credit to a too often criticised generation.

At the Royal Show the Young Farmers were able to move among the men who build the machines which are revolutionising agricultural methods and making it possible to produce two, three or four ears of corn where only one, or perhaps even nothing, was obtained before. They could inspect and criticise the products of different manufacturers—and nothing is better for the good of a business than a frank appraisal of its products. At the same time, the Young Farmers could see for themselves that neither the farmers nor the manufacturers in Britain were standing still or were satisfied that their machines and techniques had reached finality.

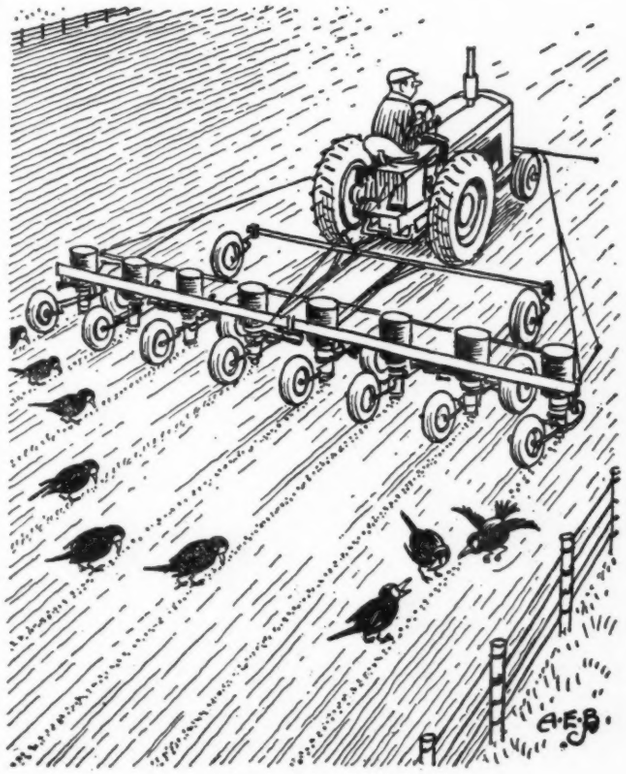
Visitors from Australia

For the third year the P. & O. Steam Navigation Co. have sponsored the visit of six Australian Young Farmers to Britain. The Canberra Award was instituted by this company to provide each year a six months' intensive study of farming methods in Britain for the best Young Farmer from each of the constituent States of Australia (see WORLD CROPS, 1961, 13, 144).

Mr. Kim Kelly, of South Australia, expressing the appreciation and thanks of these splendid young Australians, paid a special tribute to the British farmer. He said 'he would be returning to Australia changed inside and they would all lead more useful lives as a result of what they had learned in Britain'.

Visitors from Africa

From Africa, too, have come 12 Master Farmers,



'Keep to your own rows'

* The countries represented were Australia, Canada, Jamaica and New Zealand from the Commonwealth and Belgium, Denmark, France, Germany, Israel, Holland, Sweden and the U.S.A.

who will be spending three weeks on Yorkshire farms as part of a seven-week tour arranged by the British Council. These are practising farmers who, because of their efficiency, have been awarded the title of 'Master Farmer' by the Departments of Agriculture of Nyasaland and of Northern and Southern Rhodesia. Their ages range from 31 to 55 years.

The programme includes visits to farms, smallholdings, markets and agricultural shows. They will also see an experimental farm, a farmers' co-operative, a bacon factory and a seed-processing mill. They are to study the work and organisation of the National Farmers' Union and will accompany officers of the National Agricultural Advisory Service on their rounds.

This Month's Cover Picture

Egyptian scientists, authorities and farmers are enthusiastic about the way SEVIN insecticide is helping to increase agricultural profits by effectively controlling the major pests of the country's forage, fibre and food crops.

This insecticide is less toxic to humans and domestic animals, and thus safer to use than many other materials. Dust and spray applications remain active longer than most other insecticides. It is also effectively controlling harmful insects which have developed a resistance to older materials on many crops throughout the world.

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Exchange Visits

WE FEEL THAT this movement will become more general with the impending establishment of the European Common Market. The selection of 'best young farmers' to act as ambassadors of goodwill between the participating countries could do much to break down the isolation caused by national barriers and long-standing prejudices.

We would particularly like to see the Young Farmers of Ireland coming to Britain, and *vice versa*. This is an age of agricultural revolution; there is so much to be learned today that the past and all its tragic mistakes and mutual misunderstandings need to be buried and forgotten. We must live for the present and build for the future.

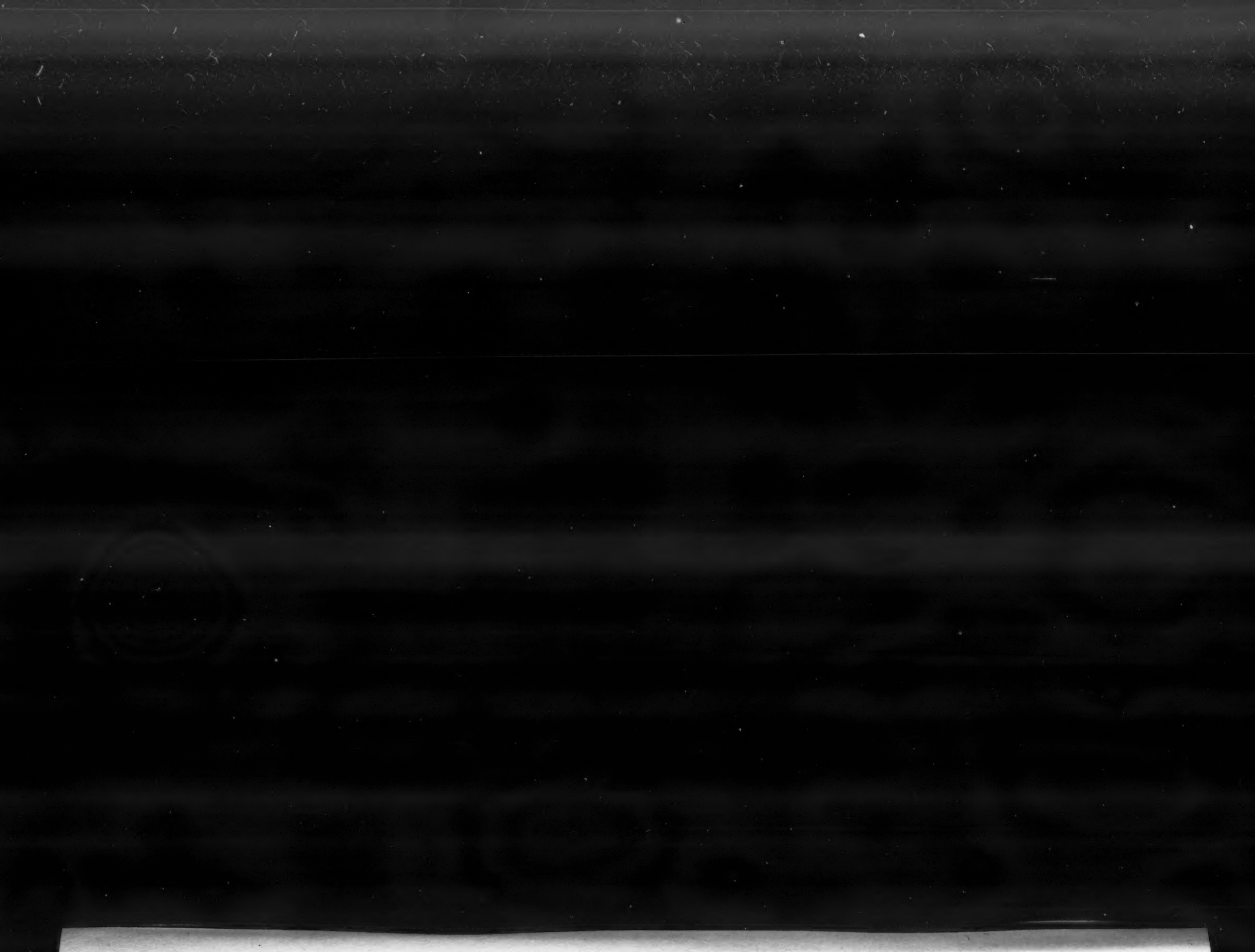
The Common Market

AT THE TIME of going to press, the British House of Commons has endorsed the policy of the Government to make formal application to join the European Economic Community, with the proviso that no agreement is to be finalised until it has been approved by the House. The Commonwealth, too, is to be consulted at every stage and a meeting of Commonwealth Ministers has been held in Accra.

Common Market ideas are spreading. In Latin America seven republics—Uruguay, Argentina, Peru, Chile, Mexico, Brazil and Paraguay—are combining and three South-East Asia countries—Malaya, Thailand and the Philippines—are also discussing the formation of a Common Market with a view to improving living standards and stabilising the markets for the primary commodities they produce. Between them they represent 80% of the world's rubber, 70% of its tin and 60% of its copra. A fourth bloc consists of the Communist countries and the fifth is made up of the dollar-based countries of North America.

The idea of such economic groupings was first put to us by a Hollander in a Japanese prison camp in 1943. He predicted that, owing to different standards of living and political ideologies, covered by the expression 'Way of Life', the nations of the world would ultimately group themselves into economic communities with similar standards and that free trading would go on between the nations of a bloc, with large-scale barter arrangements between the blocs.

At the time we were rather sceptical of his revolutionary ideas, but we live in a rapidly changing world to which we have to adjust ourselves as peacefully as possible. We have repeatedly pointed out that the gulf between the 'have' and the 'have not' nations was growing and this growing imbalance would have led to economic chaos at a time of increasing world population. The present trend promises to bring forth a new world order which may work, rather than a supra-national world government which never will.



Mechanical Ridge Planting

P. R. HILL, J. D. CRAIG and
D. M. A. MARKWEI*

Ridging and ridge planting in the tropics is usually done by hand. In this article the authors describe a system for ridging, fertiliser placement and seeding by tractor-borne implements to speed up operations and increase productivity.

Fig. 1. Toolbar arranged for ridging and fertilising, with two fertiliser containers fitted with rubber spouts and winged bodies at 42-in. centres

RIDGE crop practice is becoming widespread in world agriculture and goes far towards answering many of the problems of tropical and sub-tropical regions. Once a ridge has been correctly aligned it serves as a 'railway line' for subsequent operations. The ridge provides fair protection for erodible soils; it is of great benefit, locally, to soils poorly drained; and it is a relatively cheap form of layout for ditch irrigation. As a pre-planting cultivation it is effective for burying early weeds and, where desirable, for placement of fertiliser. It facilitates and speeds seeding and planting and enables the farmer to clean out weeds and protect his crop with less difficulty after planting.

Advantages of ridging

There are many advantages of a well-formed ridge: during high-intensity rainfall, run-off and soil movement are reduced, conserving both water and soil. Pre-planting ridging by machine marks out land accurately for hand or machine planting and fertiliser placement is made almost fool-proof. It makes earlier machine planting on the ridge possible, as ponding is restricted to the furrows and waterlogging is reduced locally.

All inter-row operation is facilitated and post-planting cultivation can be done earlier than on the flat, as plants stand erect for the weeder and the risk of covering them is reduced. Re-ridging becomes almost the equivalent of inter-row weeding. Ridging permits cheap irrigation, checks soil blow and, for groundnuts, assists digging, whether by hand or by machine.

In comparing crops such as maize, sorghum, millet, sunflowers, soya beans, groundnuts, cassava and tobacco grown on the flat and on the ridge it will be found that the ridging will increase yields. This is due to the easier management, better protection and drainage that the ridge system provides.

Disadvantages of the ridge

The disadvantages of the ridge are few: run-off water being discharged towards the main drain will gather

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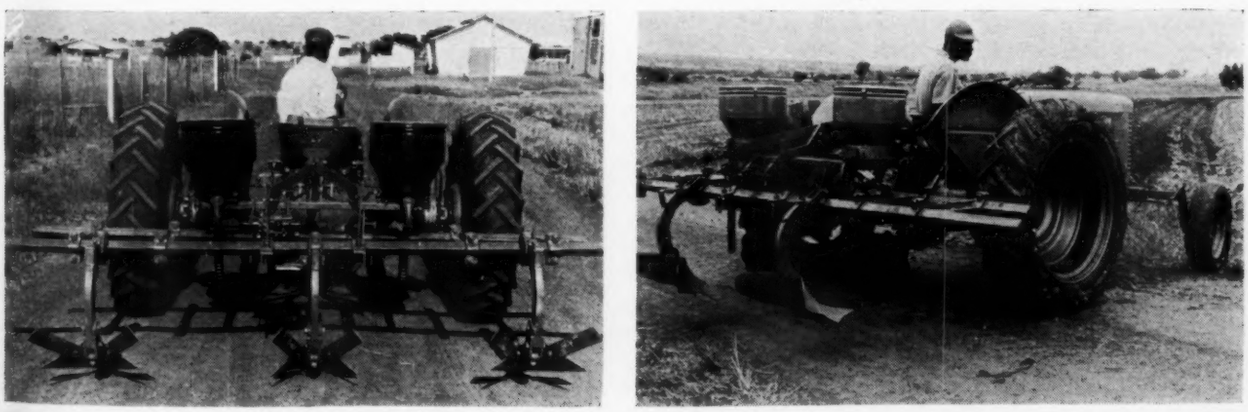

Fig. 2. Left: *Rear view of fertiliser ridger mounted on a tractor with wheels at 84-in. extension.* Right: *Toolbar set for ridge splitting and introducing a green manure crop*

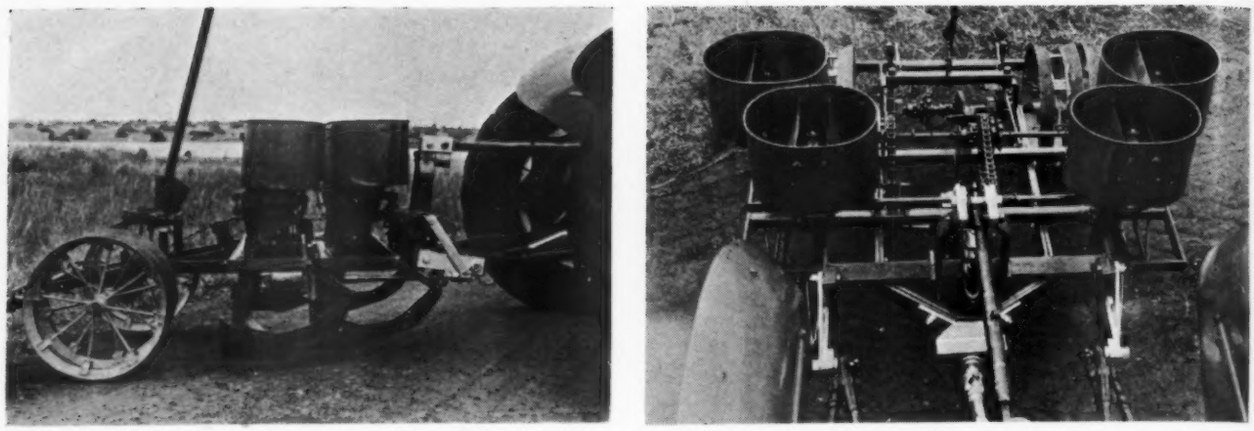

Fig. 3. Left: *Side view of the twin-row planter, showing the adjustable top link for depth control and the press wheels.* Right: *Top view of the twin-row planter, showing the offset containers and the drive*

in any low spot and so may breach a ridge, discharging its water into the adjoining furrow. This usually produces a snowball effect, quickly causing an inter-terrace gulley. Secondly, rainfall acceptance in the immediate planting area is less than on the flat if a high-intensity rain of short duration falls; and, thirdly, loss of soil moisture through evaporation is higher than on the flat, due to the larger soil surface exposed, though this is not the case once the ground is covered by the crop.

Ridge design

It is important to form ridges with care and to use as wide a *ridge* width (not necessarily *row* width) as is possible, for the wider the ridge the more robust it is.

Robustness of the ridges is an important consideration where they are required to carry run-off or irrigation water (or both), which may erode them, causing plants to fall and breaches to occur where the ridge is weakened.

Using a figure of 1 : 1½ for the unconsolidated soil angle of repose under average conditions, a ridge 3 ft. wide x 9 in. high will accommodate a single-row crop. Increase the ridge width by 6 in. and it will accommodate a twin-row 6-in. centre crop just as effectively, thus permitting a higher plant population. Increase the ridge width further by 6 in. (to 4-ft. centres) and a twin-row 12-in. centre will be practicable.

Fertiliser placement

The tropics and sub-tropics are now witnessing a swing back to deep placement of fertilisers, as this obviates seed or plant scorch, induces deeper root development and thus improves tolerance to drought. In the hotter regions seed germination does not usually depend on correct soil temperature, but rather on soil moisture.

Usually fertiliser can be applied more leisurely without risk of loss under dry, easy conditions well in advance of planting time. By separating ridge fertilising and seeding, hand or machine seeding can commence as soon as soil moisture conditions permit and can be done at a faster rate, thus reducing costs. Banded fertiliser placement does increase yields of certain crops, as has been demonstrated both experimentally and on a field scale, though to achieve even near-precise placement under average conditions in the field is not easy.

Ridging and fertilising

For ridge fertilising a hybrid implement has been devised, using parts taken from redundant or discarded farm machinery. Both this implement and the one described later in this article were built up on the 'Mecanno' principle in a way that farmers and extension workers with out-of-date equipment rusting around the farm, estate or station could easily copy.

With the implement shown in Figs. 1 and 2 (left) fertiliser can be placed and a useful pre-planting cultivation effected by hilling-over fertiliser deposited at ground level. The operator can see the fertiliser dropping and, provided it is a free-running powder, the risk of blockage is small. The rubber spout is normally used braced forward, but it can also be directed as required over a radius of about 12 in.

The implement consists of a tractor with a home-built toolbar, mounting two fertiliser cans from a 433-type Massey-Harris planter with rubber spouts and 21-in. winged hilling bodies on 3-ft. 6-in. centres. A positive drive is assured from the tractor p.t.-o. through a detachable belt pulley gearbox. Any type of hilling body, or even disks, could alternatively be used, depending on the soil conditions, and any type of fertiliser can could be mounted and the unit geared for the required application rate.

This machine for producing a fertilised ridge was designed to enable subsequent seeding by hand or by machine to take place without delay immediately soil conditions are right. The advantage of the prepared ridge are numerous: on the flat post-planting

Fig. 4. *Rear view of the twin-row planter riding the ridges*

cultivation may be delayed due to wet spots in poorly drained soil. Furthermore, essential though the timely control of weeds may be, this may be impossible without ridges due to the risk of covering the plants.

The disadvantage is that dry surface soil is buried during ridging and moisture is lost through exposure of damp soil; blockages occur where the seed or the fertiliser spouts have to pass through moist soil; depth-control wheels quickly become blocked due to continuous contact with the moist soil and, if scrapers are set too fine, the seeding rate may be reduced where the unit is wheel-driven and the seeding depth may be upset due to the unit driving instead of riding.

Fig. 5. A healthy stand of twin-row planted soya beans

Twin-row planter

Planting on the ridge obviates these disadvantages and even on sidling ground on the contour (provided stabiliser bars are used) the planter will ride on the ridge, especially where a twin row is being seeded. The machine to do this is shown in Figs. 3 and 4. The tractor carries two 433-type Massey-Harris planter unit frames bolted one behind the other to achieve staggering of the planting boots and thereby reducing soil blockage. Both seeding mechanism and depth/press wheels are power-driven from the tractor p.t.-o. through the same belt-pulley gearbox.

It is important that the drive should be applied in this way, as the depth/press wheel is always working over soil disturbed by the planter boots and, particularly in clayey soils, needs scrapers. With power-driven wheels scraping is positive and this obviates increase of wheel diameter and thus reduced depth of seeding. A shear pin on the drive sprocket is necessary to allow for roots or small stones wedging and locking the wheel and scraper.

Green manuring

After harvest, where desirable, ridges can be split by mounting two bodies and, depending on the level of trash, cutaway rolling adjustable-depth coulters can also be mounted and the fertiliser cans used for broadcasting seed of a green manure crop, such as sunn-hemp. Ridges can then be split back to their original alignment, burying the green manure seed in the process. Fig. 2 (right) shows the machine used for splitting the ridges following the harvesting of maize, groundnuts, velvet beans or soya beans (Figs. 5 and 6).

Twin-row ridge planting

To the progressive farmer a three-body unit for building two ridges at a time may seem inefficient, but with wheels aligned with the outside bodies this arrangement does ensure equal ridge spacing without the use of markers; moreover, spacing is determined partly by the twin two-row planter which follows. Such a simple approach may be helpful for the farmer or extension officer having less skilled operators at his disposal. By extending the tractor wheels to 7-ft. 6-in. or even 8-ft. centres, the width of the twin row may be increased where wider spacing is required.

The unit is set up to follow the two-ridge fertiliser unit and, having two inclined seed plates per can, it seeds twin rows 6 in. apart. This would also allow mixed cropping by filling each half of the cans with different seed. This is especially useful for mixed silage crops, such as maize and velvet beans; this crop was machine seeded and, in spite of receiving 16 in. of rain within 17 days one month after planting, yielded 10 tons per acre.

Ridge formation by machine has been stressed because, in the first place, no crop will yield satisfactorily here unless soil and water management is correct. Inadequate protection of soil against run-off water and lack of provision for drainage have spoilt many a field experiment. Secondly, although complete mechanisation of agriculture may be uneconomic, socially undesirable or beyond the capacity of the peasant farmer, agricultural productivity of the developing countries must be made to increase and there is adequate evidence that for certain specific tasks mechanical power efficiently applied is the answer.

Provided the fallow period is adequate, the traditional system of shifting cultivation protects land and maintains fertility. It is a mistake to assume that tropical peasant farming is as crude and inefficient as its appearance would suggest.

Fig. 6. Toolbar equipped with powerful spring tine blades for lifting twin-row groundnuts

British Guiana. A rural scene in British Guiana. Paddy being threshed by a team of bulls

Combine Harvesting Rice in the Tropics

Progress or Problems?

M. H. BREESE,* B.SC., D.I.C., F.R.E.S.

The author of this article points out how the introduction of combine harvesting into rice growing in the tropics raises fresh problems and he concludes with a warning not to force the pace of progress.

RICE production in British Guiana has become mechanised to a high degree. In fact, Grist[1] states that 'in no other country has mechanised paddy production been so widely or rapidly adopted as in British Guiana, where its influence is already reflected in the extended area under the crop and larger units cultivated under one ownership'. In 1959 it was estimated that 70% of the rice grown was cultivated mechanically and that 30% of the crop was mechanically harvested. Recently there has been a very rapid increase in the amount of grain reaped and threshed by combine harvesters.

Two major problems

British Guiana has, however, two serious rice problems, namely, a very high incidence of the weed red rice and serious insect infestation, with consequent high losses of paddy in storage. To what extent may these problems be correlated, if at all, with the mechanisation of operations, particularly those of harvesting and threshing?

It is a well-established fact that paddy (unhulled or rough rice) is much less susceptible to infestation than milled rice and in the rice-producing areas of the East it remains relatively free from infestation, even when stored for extended periods. This could be due to the lower moisture content of rice stored in the East, for, as Grist points out, 'the Asian cultivator is usually well aware of the necessity for storing rice in a dry condition', and in Burma and Ceylon sun-drying may lower the moisture content of paddy to 7-8%.[2] More usually, however, paddy is stored at a moisture content of 10-11%.

The drying of paddy is normally fairly difficult in British Guiana, where over 3 in. of rain fall during the harvest months of September and October and the rainfall increases rapidly in the following month, and this difficulty is aggravated by combine harvesting, which in any country and with almost any grain creates a drying problem.

But a low moisture content, although it limits infestation by many pests, is not in itself a defence against *Rhyzopertha dominica*, the principal pest of stored paddy. At favourable temperatures this insect can maintain a high rate of oviposition at moisture contents between 9-14% and its rate of multiplication also remains high

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until the moisture content falls below 11%.[3] On the other hand, its ability to bite through the rice husk, which is normally negligible, is not increased at high moisture contents.[4] Heating due to high moisture contents can, however, quite easily raise the temperature of the grain to 34°C, at which the larvae of *R. dominica* can gain entry into the husk in ways that result in very high mortalities at lower temperatures. Once within the husk the larva can complete its development, even if the paddy is subsequently cooled and dried to normal storage levels.

Rice-drying facilities

Drying facilities available in British Guiana are almost entirely in the form of large concrete floors outside the mills and their main use is for drying parboiled paddy before it is milled. Hand-harvested paddy usually comes into equilibrium with the atmospheric humidity at about 14% moisture and it is usually stored at this level of dryness. Combine-harvested paddy is, however, harvested much wetter than this and requires further drying before it can be satisfactorily stored. Millers attempt to avoid drying, either by parboiling or by milling combine-harvested paddy first, but the amount of paddy now being mechanically harvested is outstripping the availability of drying facilities and the result is an increased amount of grain spoilage and 'stack burn'.

Combine-harvested paddy not only has a higher moisture content, but it is also often more difficult to dry, and this is particularly true of that produced in British Guiana. At the present time almost all the rice varieties grown in the territory are 'date-fixed', that is to say early or late planting make little difference to the flowering date because this is governed by the day-length.[5] The most widely grown variety is No. 79, a 'date-fixed' rice, which produces a milled grain eminently suitable for the export trade, but which lodges badly.

Early combine harvesting

Combine harvesting, therefore, tends to be undertaken a little early, before the rice has begun to lodge, and the cylinder and concaves of the combine are set to deal with rice that is a little green. One consequence is an increase in the amount of dockage and broken straw in the grain, and it is well known that this foreign matter is usually of higher moisture content than the grain itself and so retards drying.[6]

In addition to forestalling lodging, early harvesting also has the effect of reducing the amount of red rice that is shed. This weed matures some days in advance of cultivated varieties and has a high degree of shedding on ripening, so that if harvesting is carried out when the cultivated variety is mature much red rice has already been shed. This problem is aggravated by lodging because combine-harvesting losses in lodged rice are normally high (usually at least three bags or 420 lb. per acre) and much of this will be red rice.

The amount of broken straw and dockage found in the grain that has been harvested by a combine from lodged rice is as high, or often higher, than that harvested a little early. Combine-harvested paddy in British Guiana tends, therefore, to have a high proportion of foreign matter for two reasons: it has been harvested early or from lodged plants.

Storage pests

Most losses in stored paddy in British Guiana are caused by the lesser grain borer, *R. dominica*, but much damage is also said to be done by the lesser rice weevil, *Sitophilus sasakii*. High moisture contents, coupled with favourable temperatures, can increase the reproductive rate of both these pests, but these conditions do not in themselves render paddy susceptible to serious attack by either.

Neither insect can feed on a grain with an intact husk and in *S. sasakii* inability to feed also means inability to lay because the female bores with her snout the hole in which the egg is deposited. *Sitophilus sasakii* is therefore entirely dependent on husk defects to infest paddy and it cannot reproduce in sound grain. *Rhyzopertha dominica* lays its eggs outside the grain and entry into the grain is effected by the first instar larva. Larvae do not appear to be able to bore through the husk, but they readily make use of even minute husk defects and can also reach the kernel of a sound grain by boring along the centre of the rachis. Entry by this latter method is easier in incompletely developed and green grains than in those that are full and mature, but even under optimum conditions larval mortality is high.

An essential requirement for the

A combine harvester working in lodged paddy

Left: *Threshing paddy by bull-mashing.* Right: *Threshing paddy by tractor-mashing*

infestation of a paddy grain by *R. dominica* or *S. sasakii* is some form of husk defect. This defect may take the form of a gaping of the hulls owing to their failure to close properly after blooming, or the lemma and palea may be separated slightly on one side of the grain only. It is unusual for either of these defects to occur in such measure as to greatly increase the infestibility of paddy and infestation almost always occurs through splits in the husk that have been caused during harvesting. A high oviposition rate depends on adequate feeding and this can only occur when husk damage is sufficiently severe to expose the kernel.

Methods of threshing

The degree of husk damage may be related to the method of threshing. In Trinidad, where this is done almost entirely by hand, the amount of husk damage is small and, although the methods of storage do not differ in principle from those obtaining in British Guiana, infestation in stored paddy is low even after prolonged storage.

In British Guiana two methods are used to thresh rice that is not combine-harvested. The traditional method known as 'bull-mashing' consists of laying sheaves two or three deep round a stake and then driving buffaloes or cows slowly round and round to trample out the grain. Alternatively, a tractor with rubber-tyred wheels may replace the cattle, and this method is known as tractor-mashing. A comparison of samples of paddy threshed in these different ways is given in Table 1.

Table 1

Comparison of the percentages of grains with split husks, hulled grains and dockage in samples of 30 g. (approx. 1,000 grains) of paddy threshed in different ways

How threshed	*No. of samples*	*Grains with split husks, av. %*	*Hulled grain, av. % (weight)*	*Hulled grain, av. no. of pieces*	*Broken pieces, av. wt., g.*	*Dockage, av. %*
Combine harvester	18	8.2	1.3	33	0.012	1.25
Tractor-mashed	9	5.1	0.15	4	0.011	1.11
Bull-mashed	9	5.5	0.19	8	0.009	1.24

Extent of damage

The proportion of grains with split husks is significantly higher in combine-harvested paddy than in that threshed by tractor- or bull-mashing, but this figure alone does not give a true indication of the infestibility of the grain. The extent of the husk damage is indicated by the number of pieces and total weight of hulled grain. This, it will be seen, is much higher in combine-harvested paddy, in which

A drying floor attached to a rice mill

the husks of far more grains have been damaged to such an extent that the kernels are separated out and subsequently broken.

The average weight of the pieces of hulled grain in each category of paddy does not differ greatly and it represents roughly half the weight of the kernel of a grain of the commonly grown varieties. Thus most grains that are hulled during threshing are also broken in half. These broken hulled grains and those in which the husk is so damaged that the kernel is exposed provide food for the insect pests that are not able to feed on unhulled grains and enable them to develop eggs that are laid through smaller splits.

In so far as split and hulled grains are concerned, combine - harvested paddy in British Guiana is no more infestible than that harvested in the same way in Texas and Louisiana, where surveys have shown that an average of 4.6% of the rice received at commercial driers is without husk.[7] Any difference in infestation in stored paddy should, therefore, be due to differences in the initial exposure to infestation and to different methods of storage.

Methods of storage

In Louisiana in 1951, 75% of the commercial storage capacity was in the form of 'flat' warehouse storage units, in which the paddy was stored in bags.[8] In Texas at this time 'flat' warehouses constituted a little over half of the commercial storage capacity, whereas in Arkansas practically all these facilities were of the bulk storage type. In the ensuing 10 years there has been a tremendous increase in the amount of bulk storage in Louisiana and Texas and now virtually all paddy is handled in bulk.

Most of these commercial storage units for paddy operate in connection with a rice drier and the usual practice is to move the harvested rice in bulk grain carts from the combine to trucks and then transport it in bulk to the drier. At the drier the rice is dumped into the receiving bin and moved immediately into the drier for the first stage of drying.

On-the-farm storage is practised to a greater extent in Arkansas than in the Gulf States, but even here the volume thus stored probably does not amount to more than 5% of total production. Circular steel bins with a capacity of up to 50 tons have been widely adopted and in recent years a great deal of work has been done at experiment stations on drying, by forced ventilation, of rice stored in these bins.

Commercial bulk storage of paddy has an advantage over storage in bags in that the grain can be reconditioned more readily, since it can be moved from one bin to another and through a cleaner or drier with the mechanical equipment of the storage unit. Bins may be more effectively fumigated than open warehouses used for storing bagged paddy. A logical development from in-bin drying was circulatory fumigation with the use of the mechanical aeration equipment and this system has now been extended to fumigation in flat bulk storage and in railway freight cars.

Paddy storage in British Guiana is entirely in bags, even at the few large well-equipped mills. One of these has storage capacity for 260,000 bags (16,250 tons), but most of the paddy is stored at small mills—of which there are about 200 scattered over the rice-growing areas—or by the rice farmers themselves. The rice farmers store their bagged paddy in the best way they can, but often this means little more than giving it protection from the weather by stacking it beneath their houses.

Storage facilities at the small mills are, in the main, extremely poor and their construction is such that thorough disinfestation is extremely difficult. New bags are seldom provided for the freshly harvested paddy and, although the old bags used may have been subjected to a certain amount of brushing and sunning, they undoubtedly harbour some residual infestation.[9] Even bags passed through a bag cleaner at a large central mill have been shown to be infested to quite a considerable extend.

Summing up

Owing to rapid increase in the use of combine harvesters, much paddy is liable to infestation by pests. The use of secondhand bags tends to expose paddy at an early stage to infestation, and inadequate drying facilities and poor storage conditions favour infestation.

Insecticidal control measures applied to the outside of stacked bags may limit the spread of infestation, but only fumigation can control it.

Strenuous efforts are being made by the Department of Agriculture in British Guiana to develop stiff-strawed varieties of paddy that are not only suitable for combine harvesting, but which will also allow the harvest period to be extended.

Bulk storage on a small scale is uneconomic and on a large scale it entails centralisation of milling facilities and the transport of paddy over increasing distances. Unless overland transport is easy and relatively cheap, which it is not in British Guiana, and the paddy can be transported in bulk, the transference from bags to bulk at the central storage unit merely involves increased labour costs. Another disadvantage is that where the number of small-scale rice producers is large, there is the difficulty of separating and distinguishing numerous small lots.

These and other considerations, particularly those of the high foundation loads imposed by silos of economical proportions on low-lying clay soils, led to bag storage being proposed for all paddy-collecting centres in a centralised mill project put forward as recently as 1958.[10]

It would perhaps be incorrect to state that events in British Guiana have underlined what Sir Alexander Fleck has said about the inadvisability of thrusting undiluted Western techniques of mechanisation on primitive smallholdings;[11] they do, however, give a pointer to the problems to be faced when the development or modernisation of one part of a production sequence outstrips the others.

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Problems of Water Control

IN most countries there are problems of water control associated with the production of food and economic crops, such as sugar, rice, rubber and coconuts. They fall into two main categories: the need for effective drainage where the rainfall is excessive, and the need to conserve water where the rainfall is slight or erratic. Crops may be lost equally by destructive flooding and sour, waterlogged conditions as by lack of rainfall and non-availability of water from reservoirs.

The proper maintenance and conservation of river systems is therefore a matter of supreme importance. The free outfalls to the sea must be secured by straightening and deepening of channels, by the removal of sandbanks and by cutting of outlets to the sea, where necessary, so that flood waters can freely escape.

Having established an effective main outfall, the next thing is to establish a reserve of water by a system of dams, sluices and water-gates, and to set up a supporting network of minor waterways. *Priestman* excavators and floating dredgers are being widely used in all parts of the world for land reclamation operations, for cleaning out rivers and irrigation channels, and for cutting new drains.

The 'Panurgic' grab dredger is designed for the deepening of rivers, the removal of mid-river shoals and the building of bunds or flood banks. The work of cutting and maintaining new waterways up to 100 ft. in width calls for the long-radius dragline machine and for swamp clearance; crawler tracks make it possible to operate in very soft ground. In the case of narrower channels, often in places where access is difficult, the smaller 'Wolf' and the 'Cub' can be used. The majority of these machines use the usual dragline equipment, but where space is restricted, such as in a closely planted rubber estate or where one bank of the channel is obstructed, a side dragline is used, as shown in the illustration (left).

Priestman 'Cub V' excavator, fitted with side dragline equipment, excavating a drainage channel for a water board in Yugoslavia

Two Priestman 'Wolf IV' excavators belonging to the Department of Agriculture, Sierra Leone, working on rice swamp clearance

Colonial Research Grants

£22 million for Research since 1940

Further details of Colonial Development and Welfare grants which were approved last year for 134 new research schemes and 82 supplementary schemes have been approved. These grants bring the total sum allocated to Colonial Development and Welfare research schemes since 1940 to nearly £22 million (see also WORLD CROPS, 1961, **13**, 262).

Of the gross allocation of Colonial Development and Welfare Funds for research during 1959-60, about 42.6% was for agriculture, animal health and forestry, 15.8% for medical research, 23.7% for pesticides research, 7.1% for anti-locust research, 2.6% for fisheries research, 2.4% for products research, 2.1% for social science and economic research, 1.9% for tsetse and trypanosomiasis research, and 1.8% for miscellaneous schemes.

About 33.5% of the gross allocation was for research schemes to benefit the East African territories. 15.5% for South-East Asian territories and Hong Kong, 12.5% for the Caribbean area, 7% for the West African group, 1% for Northern Rhodesia and Nyasaland, and 30.5% for other territories.

Distinguished Service to World Agriculture

Dr. E. Holmes, Technical Services Director of Plant Protection Ltd., retired at the end of July, after completing 33 years of service with Imperial Chemical Industries.

He has held many high offices—president of the Industrial Pest Control Association (1944-46), chairman of the Association of British Manufacturers of Agricultural Chemicals (1951-53), chairman of the British Weed Control Council (1953-59), and has been a member of several Government and other technical committees dealing with crop protection.

PROBLEMS OF PEAT

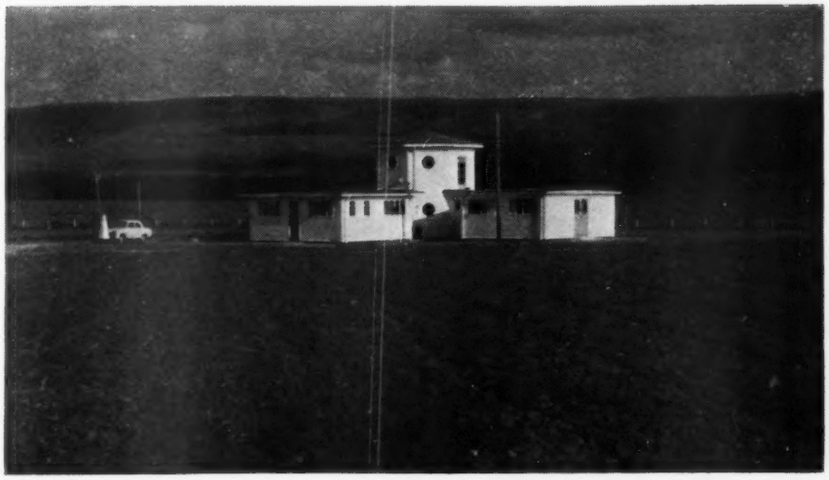
Achievements of the Irish Peatland Research Station

REVIEWED BY FRANK COOKE

The author of this article, who has previously studied the utilisation of deep peat soils for the cultivation of coconuts and pineapples, and of associated catch crops, such as sweet potatoes, tapioca and yams, in the State of Johore in Malaya, recently accompanied the Scottish Peat and Land Development Association on a tour of the peat bogs of Ireland which was organised and arranged by the Irish Sugar Company.

THE Peatland Experimental Station, Glenamoy, is one of a number of research stations administered by *An Foras Taluntais*, the Agricultural Institute of Ireland (Director: Dr. T. Walsh). It is located in N.W. Mayo, in the extreme west of Ireland, in a remote spot, about 36 miles from Ballina, and it works under the direction of Mr. P. J. O'Hare.

A fully equipped meteorological station provides records of rainfall, humidity, air and ground temperatures (from 2-12 ft. at 2-ft. intervals), sunshine and wind. Evapo-transpirometers indicate the moisture losses due to the combined effects of evaporation and transpiration. Equipment is also being developed to record the quantity of water flowing in the drains. These records, collected over a period of 10 years, will provide an overall picture of the water balance of the area.



Glenamoy Peat Research Station, Co. Mayo, is in the centre of a vast area of blanket peat as seen in the foreground

Buildings on peat

The climate is oceanic with severe gales in practically every month of the year. The annual rainfall of 50-55 in. is distributed over some 270 days. The situation is very exposed, the ground is soft and yielding and occasional gales of over 100 m.p.h. together present special problems of housing and shelter for man and beast.

For this reason the laboratories and other buildings themselves are experimental, having been built on peat varying in depth from 9-18 ft. with indicated stability only for loads not exceeding 2½ lb. per sq. in. The buildings have been constructed on steel rafts laid on the levelled surface of the bog and all are, of necessity, single-storied buildings constructed of timber, sheeted externally with weatherboarding and internally with plasterboard. The roofing is asphalt laid on timber rafters and all timber has been specially treated. Externally the buildings are of very attractive appearance and inside they are comfortable and well planned.

Conditions and soil

The experimental area of some 900 acres is on gently sloping land and has a mean elevation of 100 ft. a.s.l.; the peat type and climatic conditions are typical of those for about 1½ million acres of the low-level west coast 'blanket' bogs of Ireland.

The peat is moderately decomposed and lies directly on a shallow highly podsolised soil. The underlying rock is a fragmented, slightly metamorphosed, fine-grained sandstone. The vegetation consists mainly of *Schoenus nigricans* (black bog rush), *Eriophorum* sp. (cotton grass), *Molinia coerulea* (flying bent), some *Calluna vulgaris* (common heather) and a small amount of sphagnum.

Objectives

The station was started in August 1955 and the experimental programme is designed to determine the best and cheapest method of reclaiming and fertilising bogland and the most suitable crops to be grown thereon.

The investigations at present in progress fall into five groups: (1) drainage experiments; (2) pilot experimental farm; (3) crop husbandry and grassland establishment; (4) livestock experiments; and (5) horticultural and industrial crops and trees.

Drainage investigations

The drainage problems encountered in peatland reclamation are very different from those of mineral soils and the drainage techniques which have been developed by the Irish Peat Board, *Bord na Mona*, for the commercial utilisation of peat are seldom suitable for agricultural purposes. The drainage pattern here originally

The Glenamoy mole plough. I, peat intake; P, plough point; B, sod breaker; S, streamlined end; H, hollow plough body; G, hollow sod guide

consisted of open drains spaced at intervals of 50-100 ft.

It has since been proved that this spacing did not provide adequate drainage for agricultural purposes, for only very slight depression of the water table has been observed at 6 ft. from the drain edges. The disadvantages of such open drains, too, are that they hamper normal farming operations and are hazardous to livestock.

An area of 140 acres has now been set aside for drainage experiments. The programme consists of an evaluation of the system now in use, the drainage requirements of peatland for agricultural purposes and the development of new techniques to meet these requirements. Records are being kept of water-table heights and fluctuations and the rates of bog shrinkage with different drain spacings.

This investigation is confined to spacings of 25 ft., 50 ft. and 100 ft. Daily readings are taken of the height of the water table at different distances from the drain edge, using steel tubing as permanent boreholes. Bog shrinkage is also being measured, using steel rods protruding above the surface and firmly embedded in the underlying rock.

To overcome the disadvantages of open drains a remarkable mole plough has been developed which produces in one operation a covered subsoil drain, called a tunnel drain, with the spoil evenly spread over the land. These drains are cut at 12-ft. intervals. After this operation the broken but level ground is in a condition ready for immediate over-seeding and fertilising. The area is divided up into fields by large open drains at 200-ft. intervals into which the numerous mole drains deliver water continuously.

Experiments are in progress to assess the optimum frequency and depth of drains for various crops. This is also designed to assess the effect of cropping, manuring and cultural treatments on the reclamation of peat for agricultural purposes.

In one investigation one acre was tunnel-drained and one acre was left undrained. Both areas were treated with 30 cwt. of muriate of potash and 2 cwt. of nitrolime and they were overseeded with 28 lb. of a mixture of New Zealand ryegrass, white clover and Yorkshire fog. The results are being measured by the increase in the liveweight of the animals, but the vast superiority of the properly drained pasture was already obvious.

As the work progresses information will become available regarding permeability, the capacity of various plants to extract moisture from peat, depth of root penetration, changes in the physical and chemical structure of the peat and the rate of shrinkage of this peculiar soil.

Pilot experimental farm

A farm unit has been set up to apply knowledge already available on peatland reclamation and test the results of research now in progress. Detailed costs of each operation are maintained to estimate the economics of farming on peat, *i.e.* whether a living can be obtained on a peatland farm of this size.

An area of 100 acres has been allotted for this unit, with an additional 40 acres of woodland planted in the form of shelter belts necessary in this very exposed country. It is run as a mixed farm with a present population of 33 cows, 25 followers, 37 pigs and a herd of black-faced sheep.

The system of shelter belts consists of individual plantations 100 ft. wide, spaced at intervals of 100 yd. and 250 yd. The species include mountain pine, Sitka spruce, *Pinus contorta*, Japanese larch, birch, alder and other minor species for observation.

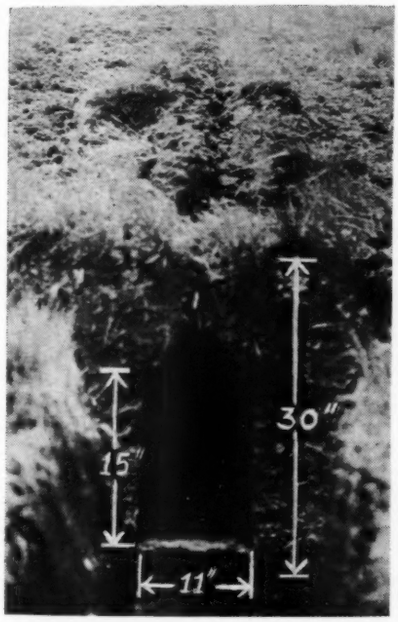
The farm is divided into fields, five of which are 100 ft. wide and the

Rear view of the mole plough entering the peat from the main drain. These tunnel drains are made at 12-ft. intervals

remainder 50 ft., as necessitated by the original drainage system. The strips between the drains were first cambered with a screw land leveller to ensure good run-off into the drains and to present an even surface for the cultivation, fertilisation and harvesting of crops. The farm commenced operation only in August 1957, but already important conclusions have been reached.

Thus the initial standard manuring for both cereals and grasses was 3 tons of ground limestone, 6 cwt. of superphosphate (8% P), 3 cwt. of muriate of potash (50% K) and 2 cwt. of calcium ammonium nitrate. Experiments have since shown that the heavy initial dressing of ground limestone can be reduced and that light annual dressings are better. The addition of 20 lb. of copper sulphate per acre has been found absolutely essential for the production of satisfactory crops of cereals

Side view of the mole plough entering the peat from one of the main drains set at 200-ft. intervals



The finished mole drain with the surface covered with a wet mulch of disintegrated peat ready for seeding

and this is now also included into the standard manurial programme for these crops and for grass. The essential importance of the phosphate fertilisers has been fully confirmed.

Cobalt deficiency was found on all sheep-grazing pastures, but dosing with cobalt pellets has remedied this. One case of louping ill has been confirmed, but there have been no losses attributable to fluke.

Hay is conserved quite successfully on quod pods and silage is also made. The grazing system is rotational and to implement this netting wire is laid over the open drains. Over-grazing of young swards and winter grazing is very deleterious under peatland conditions and the cattle are consequently housed in late autumn and during the winter.

At the moment one of the greatest difficulties is the development of suitable machinery for transport and for the cultivation and harvesting of the crops and pastures. This is of fundamental importance where the economic utilisation of peatland is concerned. The principle at present being followed is to graze the cattle for five months and feed them on hay and silage during the wetter months. Oats have not been found to be an economical crop to harvest due to the mechanical problems.

Crop husbandry and grassland

Varietal and manurial trials are at present carried out on general farm crops, including cereals, roots, forage crops and grassland to ascertain the varietal and manurial treatments best suited to peat.

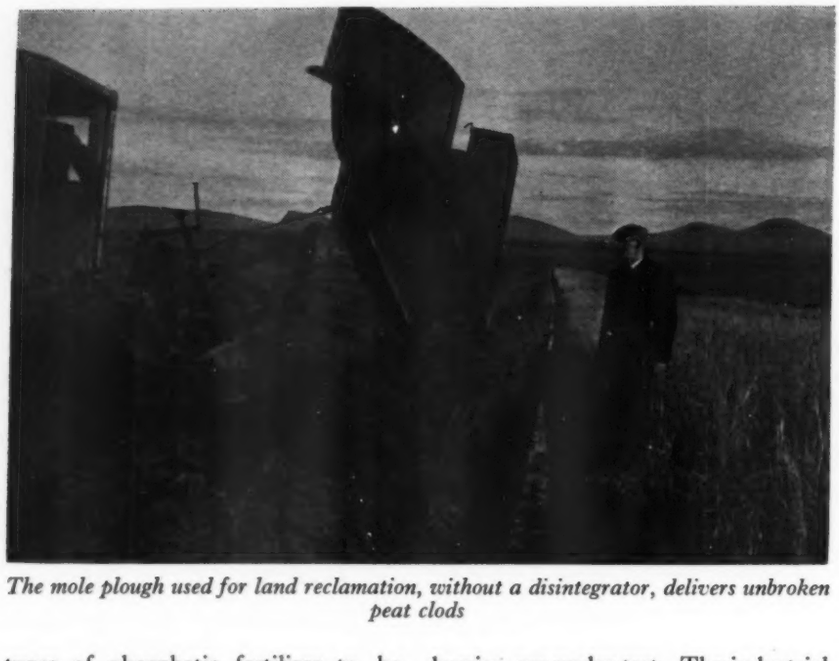
One important aspect of bog reclamation is the determination of the most suitable sequence of crops. Experiments have been laid down to ascertain the best rotation necessary to ensure adequate breakdown of the peat and produce good physical conditions for plant growth.

The importance of minor elements in crop production was strikingly demonstrated in the early years of the station. Crops of oats and barley which had received adequate dressings of the major nutrients have produced normal quantities of straw, but very little grain indeed. Trials were then laid down using incremental dressings of copper sulphate and sodium molybdate, both as soil dressings and as sprays.

Very spectacular responses were obtained from copper sulphate, but molybdenum has little effect. Further experiments were undertaken to determine the optimum quantities of copper necessary and to ascertain the residues. This work is obviously so promising that its scope has been extended to investigate the trace elements necessary for production of a wide range of both agricultural and horticultural crops. Work is also in progress to determine the optimum amounts required and the specific roles of trace elements in plants.

Over-seeding trials

Different methods of peatland reclamation and improvement of native sward have been tried out. One technique which has given very satisfactory results is over-seeding. Trials were laid down with two different seed mixtures and incremental amounts of N, P and K in the presence of and in the absence of lime. Trials were also undertaken to find the most suitable



The mole plough used for land reclamation, without a disintegrator, delivers unbroken peat clods

types of phosphatic fertiliser to be used in conjunction with the trace elements.

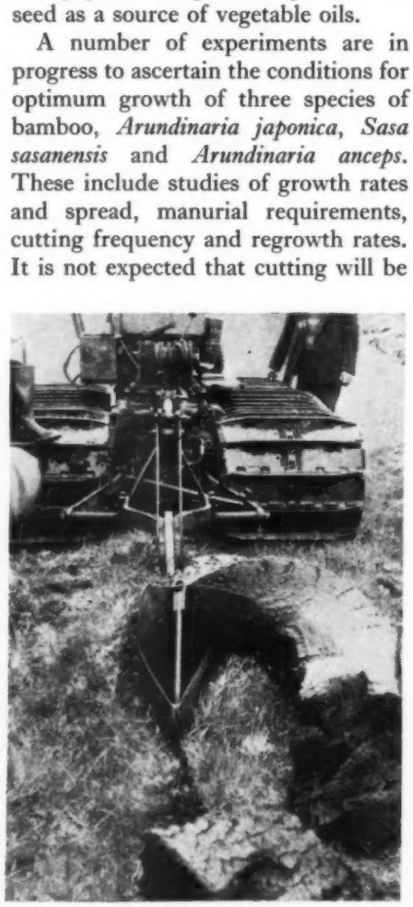
These trials have been remarkably successful and the most promising results have been incorporated into a large-scale trial covering approximately 70 acres to determine the effects of the grazing animal—cattle and sheep—on sward establishment and its survival. The over-seeding method has now been applied to large areas of peat as an economical method for sward improvement, and trials have been laid down by the Agricultural Advisory Officers in counties Donegal, Galway, Clare and Kerry. One important conclusion is that the application of fertilisers to a native sward alone is not enough; over-seeding is an essential requirement.

The livestock programme includes trials on various breeds of sheep and cattle to determine the most suitable type under the exposed conditions obtaining at Glenamoy. About 30 acres have been laid down to grass to provide an area low in copper and molybdenum which is suitable for trace element experiments on livestock.

Horticultural and industrial crops

An extensive programme has been undertaken on horticultural crops and some industrial crops are also under test to assess their potential as a source of raw materials for industry. Most of the vegetables and also some fruit crops, *e.g.* blueberries and cranberries, are under test. The industrial crops investigated include New Zealand flax, hemp for fibre, bamboo for fine paper-making, and rape and linseed as a source of vegetable oils.

A number of experiments are in progress to ascertain the conditions for optimum growth of three species of bamboo, *Arundinaria japonica*, *Sasa sasanensis* and *Arundinaria anceps*. These include studies of growth rates and spread, manurial requirements, cutting frequency and regrowth rates. It is not expected that cutting will be more frequent than once every four years. (These trials were suggested by Mr. Wilson, of Manchester, who has been carrying out bamboo experiments in Ireland.)



A mole plough, which delivers the peat in unbroken clods, at work on an area which is to be drained and settled by small farmers

Conclusion

The thoroughness with which the 41 groups of planned experiments now in progress at the station are being tackled was most impressive. The pioneer work that is being done here is of world importance, as unknown millions of acres of useless swampland are waiting to be reclaimed. The methods and the machines that have been developed and perfected in Ireland can be used in other countries.

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Research on Vegetables

The following paragraph was accidentally omitted from the account of the work of the National Vegetable Research Station in our August issue and should be inserted between the third and fourth paragraphs in column 1, page 309:

Beetroot silvering

This disease, which is caused by a bacterium, has been very prevalent in seed crops of the Cheltenham Green Top variety of red beet, sometimes causing the loss of up to 75% of the plants. The disease is transmitted in the seed and plants grown from infected seed show the disease at an early stage in the 'steckling' bed.

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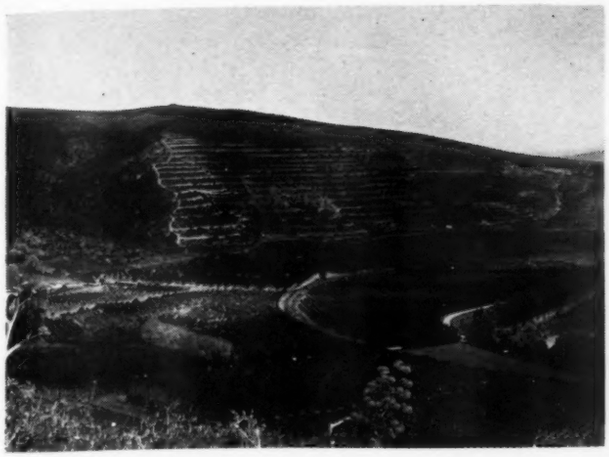


Photos: FAO

Left: *Algeria. Successful land reclamation like this can be applied in other Mediterranean countries with similar soil and climatic conditions.* Right: *Macedonia, Greece. Erosion is a serious problem and threatens whole valleys. Gullies like these can form in a few years*

Restoring Prosperity to an Ancient Civilisation

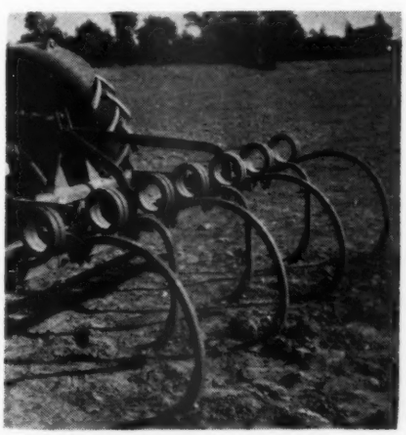
FAO Mediterranean Project

From the dawn of time until the industrial revolution in England some 150 years ago the Mediterranean basin was the undisputed centre of Western civilisation. Yet, with populations rising and the productivity of the land declining, the countries in this area are suffering from want. About 170 million people in this region — a population comparable to that of the U.S.A.—have to share a total agricultural production valued at $38,000 million, which is less than a tenth of that of the U.S.A.

The economic growth of the region is not, as in other under-developed regions, the spontaneous and enthusiastic venture of nations with untouched virgin lands. In the Mediterranean the real challenge is—can the people win their country from the desert and build again a thriving and prosperous civilisation like that which existed in Greek and Roman times.

Decline of natural resources

Mismanagement of the soil has been a feature of the region for centuries, largely resulting from misguided efforts to increase production to meet rising demand. Such a robber economy that destroys forests and wastes soil has held sway in almost every part of the world, but, unfortunately, the environment of the Mediterranean is less tolerant of abuse than temperate areas. The forests and good grazing lands on mountains and hills have shrunk to one-quarter of what they were in ancient times and the remaining acreage is either covered with degraded vegetation or consists of bare rocks, denuded hillsides and deep gulleys. The poor and under-fed livestock here produce only a fraction of the milk and meat that they should.



Libya. Mechanised cultivators are now being used in dry farming operations and in 1959 helped to bring 10,000 acres of land under cultivation

Rehabilitation proposals

The first idea proposed was a vast reforestation programme, but, unfortunately, the extent of the destruction of the soil has made it impossible to re-establish the forests within, say, a decade or so.

A second notion—'overnight industrialisation'—has been tried during the last 15 years, with the help of substantial foreign aid, in almost all Mediterranean countries. Between 1945 and 1953 the national income in most of these countries rose significantly. Since then, however, progress has slowed down, come to a standstill in certain cases, and the beginning of a self-sustained growth has not occurred.

Balanced use of land

There is yet a third solution—the simultaneous development of agriculture and forestry as part of an integrated plan for general economic development. To do this the first essential is to relieve the pressure of over-grazing and to restore the forest cover and other vegetation wherever this is feasible. To this end it will be

Libya. Disk ploughs are now in use in dry farming operations over vast areas of the country

necessary to remove shepherds and their flocks from the forest and eroded range lands to reduce the area cultivated and, even the size of herds.

The key, however, is water. The long dry season, the excessive concentration of torrential rainfall in winter and the salinity of poorly drained soils have been throughout history, and remain to this day, the main limiting factor in agriculture production in this region.

Investigations by FAO show that it should be possible to increase the irrigated area by 25 million acres between 1962 and 1980, bringing the total to 45 million acres or 70% of its potential. The total cost of the irrigation programme recommended by the Mediterranean Development Project would amount to $7,300 million. Fortunately, too, as much as one-third of this cost will represent wages.

Increasing productive capacity

Irrigation would make it possible to grow more than one crop per year on the same land and double cropping with vegetables and fodder grain in rotation with crops such as cereals and cotton, is then possible. But the principal cash crop on the newly irrigated land will be fruit and high-quality vegetables. It is estimated that the production of citrus, for example, could be increased from 1 million m. tons to some 3.2 million m. tons by 1980.

New practices and modern techniques will also bring considerable changes to the 2 million acres that are now cultivated under the system of dry farming. This objective calls for the massive use of fertiliser and mechanical implements and the introduction of better seed. All these have at present largely to be imported, but it is planned to help the Mediterranean countries to establish new industries to produce them.

Restoring the forests

The steppes and marginal range lands will be used solely as rearing areas for livestock, which will then be fattened on arable land and on cultivated pastures, but at the foundation of all these plans for agriculture and animal husbandry is the programme for restoring the forests. FAO is proposing that the governments concerned should plant some 18 million acres of forest over the next 20 years and restore another 25 million acres of forest, principally in Spain, Turkey, Greece and Algeria.

Economic advance

The improvements that may be achieved by 1980 have already been forecast, but at this stage it is not possible to foresee the results and consequences. These depend on the governments of the countries concerned. FAO thinks that the Mediterranean region could achieve by 1980 an increase of $60,000 million per year in the gross output of the region.

Of this total, some $20,000 million would be gained in the Near East and North Africa, bringing that region up from its present $10,000 million per year to $30,000 million and raising *per*

Morocco. A cork oak farm established in 1953 and now being harvested by stripping the bark, as can be seen

Libya. Mr. Kansour Breigith, of Cyrenaica, was awarded an FAO Fellowship to study agriculture at the American University at Beirut. Subsequently he attended a course on seed certification and improvement in Denmark and is now officer-in-charge of the distribution of better seed to farmers

capita income from $170 to $300 per year. For Eastern Europe the objective is an increase in gross output from $26,000 to about $70,000 million in 1980, making it possible almost to double income *per capita* from $250 to $485 per year if all goes according to plan.

Obstacles to be overcome

There are three main stumbling blocks to such development: the unbalanced system of land tenure, the excessive fragmentation of farm holdings, and the primitive structure of rural society.

The transformation of the family and community spirit into co-operative spirit is the most promising way to modernise these rural societies without an abrupt departure from ancient tradition. FAO contemplates setting up a network of community development experiments, linked to the pilot zones in which the new methods of land use are to be demonstrated.

The financial problem is also very difficult and substantial foreign aid will be required.

Atomic Seeds

Over 15,000 varieties and strains of cereals have been grown at the Twyford's Pedigree Seed Trial Grounds near Banbury in Oxfordshire. Of these, about a third are varieties derived from seed which has been subjected to atomic radiation.

The object of 'bombarding' seed with atomic rays is to induce mutations or sudden changes producing characteristics differing from those in the parent strain. Mutations do, of course, occur spontaneously and definite new species and varieties arise by this means. Natural mutations, however, occur very rarely, but the frequency of their occurrence can be artificially stimulated by irradiating the seed with X-rays or by treating it with certain chemicals.

As in other plant breeding establishments, irradiation is used not as a method of producing new 'gene-tailored' varieties, but as a method of changing the genetical make-up of individual plants, producing characteristics which after careful selection and planned cross-breeding may be developed by the plant breeder to form a new variety. These induced mutations, whilst they may not themselves produce marketable new varieties, do produce new material upon which the plant breeder can work to develop a new variety.

Thus, from irradiated Hybrid 46, Mr. C. Kimber, chief plant breeder at Twyford's, has produced a plant which shows extraordinary promise, with shorter, stiffer straw and a higher yield of grain per spikelet than Cappelle and more resistant to yellow rust. This type of plant breeding research is an extremely lengthy process demanding the growth and screening of perhaps tens of thousands of plants. Up to now, the rewards for such work have been negligible and it is encouraging to note, therefore, that under the proposals put forward by the Committee on Transactions in Seeds and Plant Breeders' Rights, adequate protection and financial reward will make plant breeding work more worthwhile.

Storage of Apples

Each year for the past seven years members of the East Malling Research Station Association have met to consider how orchard treatments have affected the keeping qualities of Cox's Orange Pippin apples.

Dr. H. B. S. Montgomery discussed the degree of natural infection by *Gloeosporium* occurring in differently grown samples. Dr. R. T. Burchill next described tests he had made on the susceptibility of certain samples in the storage experiments and experiments in the orchard on the production of spores by the fungus during the year. Chemicals used in early March may reduce spore production and also the amount of rotting in store.

Dr. B. G. Wilkinson showed how the chemical composition of fruits from different orchards varied with different experimental treatments and even between individual fruits and parts of a single fruit. The evidence has suggested that low-temperature breakdown might be associated with low concentrations of potash in fruit.

Letters to the Editor

Sir,—For the second time I have observed in your editorials that you strongly condemn the use of parathion in tropical areas and you state that there are now available much safer chemicals which are just as efficient.

Unfortunately for us, your statement is not true of insect control in *arabica* coffee in Tanganyika or, for that matter, in Kenya as well. Parathion and methyl parathion (which is slightly less dangerous) are effective in destroying four quite different types of insects at the same time, *viz.*, leaf miners, *Leucoptera meyricki* and *L. caffeina* (Lyonetidae); berry moth, *Prophantis smaragdina* (Pyralidae); antestia, *Antestiopsis lineaticollis* (Pentatomidae); thrips, *Diarthrothrips coffeae* (Thysanoptera).

Three applications of the insecticide are used (sometimes more if the season of each insect does not overlap) at the rate of 0.4 lb. of parathion per acre per application. The cost does not exceed Sh. 10/00 per acre per application for the insecticide. Diazinon is the only other known insecticide which might compete with parathions if the price was comparable, but as it is the cost is over Sh. 50/00 per acre per application. We know of no other insecticide which will kill leaf miners at a reasonable dose, including 'Phosdrin', the 'consumer-safe insecticide' (though as poisonous as parathion) of which you approve.

Moreover, the parathions seem to be gentle with our beneficial insects, while other insecticides, including DDT and dieldrin, are not.

We are anxiously screening every insecticide as it becomes available in the hope that we may find a substitute for the parathions.

I am not condoning the careless use of parathion, nor would I promote its use where more suitable insecticides are available. I am making the point that we have to use parathion from sheer economic necessity. This may well be true elsewhere in the tropics.

So far we have had only one death from parathion, but in this case the man deliberately drank the copper and parathion mixture to control his intestinal worms. Farm labourers and peasant farmers have also been known to drink petrol, DDT and dieldrin sprays for the same purpose. Did you hear of the case in Nairobi where a parathion insecticide was being added to tea, at extra charge, to give the consumers an extra flip and to improve the colour of a weak brew? But the same thing has also happened with stolen methyl alcohol and other chemicals.

R. G. Tapley,
Entomologist
(Coffee Services).
Coffee Research Station,
Lyamungu,
Moshi,
Tanganyika.

[*The statement that there is no more efficient and cheap insecticide than parathion for the control of the named coffee pests is correct. The fact that parathion is available to all and sundry and may be used by unskilled people is the dangerous fact.*

Actually there are safer alternatives for the four named pests, viz.:

For leaf miners: Diazinon and possibly rogor.

For berry moth: Diazinon and malathion.

For antestia: DDT, malathion and pyrethrum.

For thrips: DDT and dieldrin.

The yardstick of price is holding up progress, for it is difficult to get responsible people to test safer products unless the material under test is cheaper than parathion.

There is an almost identical situation in Malaya, for it was not until arsenic was banned that commercial companies really took an active interest in finding safer alternatives. It is a reasonable prophecy that cheaper alternatives will be available within two years.

Similarly in the U.K. there was little interest in finding alternatives to sodium arsenite for burning off potato haulm until its use was banned. Now, I believe, there are at least three products available to the potato grower.

If the world is to be adequately fed, crop protection by agricultural chemicals must go on, but the indiscriminate sale of poisonous chemicals to ignorant people or their use without close supervision of mixing and application is almost criminal. Obviously, in the less advanced countries the system of contractors should be developed and the contractors should be trained, licensed and kept up-to-date. Ed.]

Sir,—I am somewhat surprised at the tone of approbation conveyed in your editorial of the June issue, dealing with the banning of sodium arsenite in Malaya. Sodium arsenite has proved to be a most efficient and economic herbicide for the control of weeds on estates in Malaya. There are, of course, a number of other effective herbicides available, but none of these by itself is an adequate substitute for sodium arsenite.

The decision to ban the use of sodium arsenite in Malaya in 1961 is said to be due to health hazards and to prevent the poisoning of livestock. Desirable as these issues may appear to be, they are, in fact, less significant than one might suppose. The use of sodium arsenite has been governed by the terms of a strict ordinance and, while the evidence of livestock mortality serves to indicate that control is not perfect, the loss, in terms of either finance or meat, is extremely small in proportion to the benefits achieved. The fundamental reason behind the decision to ban the use of this chemical is indeed somewhat more mundane than is suggested. It is, in fact, a response to pressure from peasant livestock owners, who, by virtue of their voting power, are now able to bring pressure to bear on the mighty rubber industry.

Democratic as this may be, it is unfortunate that an industry as important to Malaya as rubber should be deprived prematurely of a valuable tool. Had the matter been considered more effectively, it would perhaps have been appreciated that a more conservative approach would have been advisable. A major cause of livestock poisoning is imperfection in practices associated with application. Spraying techniques have received too little attention in Malaya. The equipment used is frequently primitive and imperfect in design and, equally important, contractors and personnel employed often have little or no knowledge of their

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Photo: USDA

A four-engined aeroplane, type C-g7, being used for forest insect control

Agricultural Aviation—2

The Future of Agricultural Aviation

DR. W. J. MAAN*

THE problem of feeding the ever-increasing population of this earth is accompanied by a relative decrease in the number of farmers, *i.e.* a decrease in the percentage of farmers in the total population. In the U.S.A. and in some European countries there is, with an increasing population, not only a relative, but even an absolute, decrease in the number of farmers. On the other hand, in most tropical and sub-tropical countries the farming population remains as high as 70-80% of the population. For comparison: in the U.S.A. it is 8%, in Holland 12%.

World population will this year or next reach 3,000 million and, according to UNO, this figure will by A.D. 2000 have risen to over 6,000 million, *i.e.* it will have more than doubled in less than 40 years. Already two-thirds of the world population is under-nourished and population growth is most rapid in these hungry countries (per year, in India 2%, Egypt 2.6%, Brazil 2.8%, Malaya and Ceylon 3%) and smallest in the Western countries (Western Europe 0.7% per year).

One conclusion is very obvious: a decreasing number of farmers will have to produce more food for an increasing number of people. This is still possible, provided that in areas where there is a discrepancy between population increase and food supply adequate attention is given to agricultural education and advisory work, agricultural research, improvement of operating conditions by land consolidation, irrigation etc., improvement in yields by the use of better seed and increased mechanisation to allow greater acreages to be brought under effective cultivation.

Agriculture and mechanisation

In sub-tropical and tropical countries it is sometimes argued that agricultural mechanisation would increase the already excessive unemployment, *e.g.* among agricultural labourers in India unemployment is as high as 16%. Therefore, for a well-balanced development, general industrialisation will have to go hand in hand with agricultural mechanisation.

It is incomprehensible why mechanisation in general, and agricultural aviation in particular, can be applied in the tropics and sub-tropics on big estates for the production of sugar, rubber, coffee, bananas, groundnuts, tobacco and cotton, but is not used in the production of food crops. It will be said that conditions are different, for food crops are almost invariably grown on small and under-sized holdings which are too small for mechanisation, let alone aerial applications. This is indeed true.

Besides the important task which agricultural aviation already performs in the battle for food in the tropics and sub-tropics, I have in mind locust control. Here are two more out of many possibilities:

Increased cereal yields

An FAO mission composed of soil experts visiting North India declared that, if through the application of fertilisers the fertility of agricultural land

* Director, International Agricultural Aviation Centre, The Hague, Netherlands.

in some areas could be raised, the production of cereals could at least be doubled and in some areas even increased seven times the present level. This is understandable because for centuries no animal manure has been used, as all cattle dung has been burnt as domestic fuel.

It would seem at first sight that the obvious solution would be to give farmers advice in the use of fertilisers and distribute fertilisers among them. This solution meets great difficulties: firstly, because the machinery for distribution is generally lacking and, secondly, because the farmers in the vicious circle of misery due to undernourishment and weakness are too apathetic to listen to advice. What energy they have is required for the dull routine of their out-of-date agricultural practices.

Aerial application of granulated fertilisers, provided they are of the right composition and are applied at the right time in the season, may break this vicious circle. It is not necessary to treat the areas field by field. From a greater height than is usual for aerial applications and using bigger aeroplanes, specified agricultural areas could be treated as a whole. It is true a small part of the fertilisers may land on roofs or roads, but this does not matter much, as most of the spilt fertiliser will subsequently reach the land.

The immediate effect of such an aerial dressing would be an almost automatic increase in the food production without any extra exertion on the part of the farmers. This increased food production will decrease the acute hunger and under-nourishment, the existing apathy will be broken, human energy will be liberated and the population will be ready to receive agricultural advice.

U.S.A. Spraying seed alfalfa against mites and lygus, using a Travsland Ag-2 agricultural aircraft

Increased meat production

The second example concerns the possibility of an increase in protein production. In beef production in Texas, Oklahoma, Argentina and some parts of Australia, and in mutton production in New Zealand, agricultural aviation is already now rendering good services. On 25 July, 1958, the New Zealand Minister, J. Mathison, said: 'The agricultural aviation industry is engaged in work of vital importance to our national prosperity'. This is understandable, since through aerial sowing and top-dressing alone the New Zealand mutton production has increased by percentages varying regionally from 25-60%.

Similarly, it should be possible to increase beef production in large areas of the African savannas by improving the pastures, the agricultural aeroplane being almost the only equipment required. It can free the land from undesirable grass species by the method called 'chemical ploughing', then sow good grass species, spread fertilisers, carry out top-dressing, check the growth of weeds or brush by spraying hormone - type weedkillers and, where necessary, destroy the tsetse fly by spraying insecticides. Further, the aeroplanes can be used to drop fence posts and fencing material.

A great deal of research has still to be done for a sound development of this very important branch of agricultural mechanisation. Agricultural aviation research is, however, very costly, and it is therefore important that the results of this research should be internationally exchanged between the scientists concerned so that they can build on each other's experience and so avoid unnecessary waste of time and money. Furthermore—and this is no less important—results of research must be disseminated among the users as soon as possible.

This is the purpose and work of the International Agricultural Aviation Centre (I.A.A.C.) at The Hague, Netherlands. This centre is in touch with all research workers and institutions that conduct research work relating to agricultural aviation, and keeps them informed on what is being done elsewhere. Through this pooling of knowledge and a very extensive collection of published literature this international non-commercial and non-profit-making organisation is able to advise and give information to governments and industries. Further, the

(*Continued on page* 394)

MAKING MAPS FOR AGRICULTURE

2—Agricultural Surveys from Air Photographs

M. BRUNT*

The author of Part 1 described the technique of topographic mapping from air photographs. The second author here describes the application of the results of air photography to land development programmes.

THE air photograph is particularly useful to the agriculturist because: (1) it presents an overall view of ground conditions; (2) it is a useful field document on which to record field observations; (3) it often shows more topographic detail than a map; and (4) it may show the distribution of features of interest, *e.g.* types of vegetation, soil patterns, land forms, rock formations can show up clearly. These features, having been identified, may also be mapped from air photography with far greater accuracy than is possible with ground surveying.

The use of air photographs for agricultural surveys will usually speed up the work, enable it to be done more accurately, reduce the cost and, in some cases, enable work almost impossible by ground methods to be undertaken.

Against this must be set the disadvantages. Air photographs of the area to be studied may not exist; obtaining them may be impossible because of bad weather, or because it would be too expensive to take the few required for the survey. Equally air photographs may not show the features the agriculturist wishes to study, *e.g.* many soil patterns do not show at all on air photographs.

It should be added that air photography, once taken, is seldom used by one party alone. For example, the current ecological survey of the Kenya Highlands is using 12-year-old R.A.F. photography originally taken for general mapping purposes; conversely, the special photography taken for the Gambia Land Use and Vegetation Survey has also been used to produce a series of 1 : 25,000 topographical maps.

Photo: M. Brunt

Kenya. A Land Rover in the Cambretum savanna country making a reconnaissance survey

Other regular users of air photography taken for topographic mapping, especially in the tropics, are forestry, geological and water supply departments, as well as those concerned with road construction and town planning.

The high-speed production of topographic information from air photographs is another of their important attributes. It can be effected in the following ways: either by producing tracings from individual photographs, which themselves may be enlarged with ease from their standard size of 9 in. x 9 in. to 36 in. x 36 in., or by producing sketch maps by tracing direct from print laydowns. These are mosaics produced by assembling air photographs by matching the detail at print edges and re-photographing, usually at a smaller scale. Relatively accurate plotting, but without ground control, may also be undertaken from blocks of air photography.

The factor of time

When time and costs are considered in connection with this kind of work it is very difficult to quote accurate figures because, as far as the writer knows, no controlled tests have been carried out to compare ground survey methods with the air photography techniques. An additional important factor has been the development of the *Land Rover* and other similar vehicles. These vehicles have virtually revolutionised travel in tropical countries. They are often used together with air photographs on survey projects and themselves have played a large part in speeding up surveying.

We may, however, quote the opinion of experienced workers in this field. C. G. Trapnell, who has had some 30

* Land Use Officer, Directorate of Overseas Surveys (Colonial Office).

years' experience of vegetation surveying in East and Central Africa, has suggested the following time saving: one man, once he knows his vegetation communities, and given good base maps, should be able to map 1,000 sq. miles of country of average complexity in 4-6 weeks. This is a four- or five-fold improvement on the old methods of ground survey. Similarly, at reconnaissance level, up to 20 miles per day was the maximum mileage of foot traverse work possible in the past. Using a Land Rover and air photographs, between 80-150 miles a day are possible, depending on the terrain.

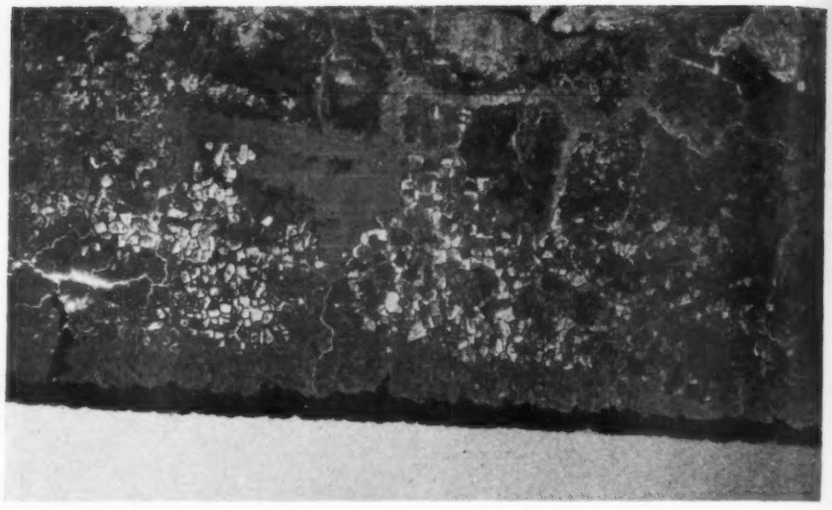
A three-man team in Kenya recently completed in one year vegetation mapping in detail of 20,000 sq. miles at 1 : 50,000 scale. It is estimated that this work would have taken three times as long without air photographs. This work was more or less equally divided between the field and the office.

In the Gambia, where the author carried out a detailed survey at 1 : 25,000 scale of 2,000 sq. miles of vegetation and land use, less time was spent in the field—just under two months. On the basis of the information gained, an air photograph analysis was carried out with the assistance of two draughtsmen which took four months to complete, *i.e.* one man-year. To have produced this information by ground methods would have taken at least five years.

These figures require a great deal of qualification, since they obviously depend on the experience of the people doing the work, the complexity of the features being surveyed, the ease of communications, and so on.

The factor of cost

Cost is particularly difficult to assess, again because no controlled tests have been undertaken. Among the many factors affecting costs is the very variable cost of the air photography, the experience and speed with which the field officers work, the amount of field work required, and so on. Since most air photography has a number of different users, and since work of a higher standard of accuracy can be carried out more quickly than by the older ground survey methods, the use of air photography must obviously reduce the cost to the individual departments.



Gambia. Bunded paddy fields, hidden behind the black fringe of mangrove swamp on the banks of the Gambia River, can be clearly seen from the air

The variable costs of air photography alone, due to unreliable weather conditions, which are the major hazard in this work, will serve as an illustration: The average cost per sq. mile for 1 : 40,000 air photography in one West African area was approximately £2 in one year and £4 in the following year.

Method of operation

What kind of surveys are required for agricultural development and how they should be carried out are two questions which will probably receive slightly different answers with each job considered.

Ideally, a complete survey of the environment should precede research and development. This, however, is seldom possible. More often one aspect of the environment has to be selected and studied, which it is hoped will answer the problems without the expense and trouble of a full-scale survey of the environment. Thus soil and/or vegetation surveys are often carried out.

Study of the actual distribution of present land use is a further technique which may be valuable. The distribution of, and differences in, present land use show the agriculturists' reaction to the environment. This, if correctly interpreted, may be a very useful guide to the problems of an area.

The actual method of working depends on whether the survey is a detailed one or is simply a reconnaissance. In the former the photographs are usually studied stereoscopically and any discontinuities in the features being studied are marked on them. The photographs are then taken in the field; often they are then mounted on a board, nine at a time, to make a photo mosaic, and the annotations are checked against field evidence. Further stereoscopic analysis in the office allows corrections to be made in the light of the field work.

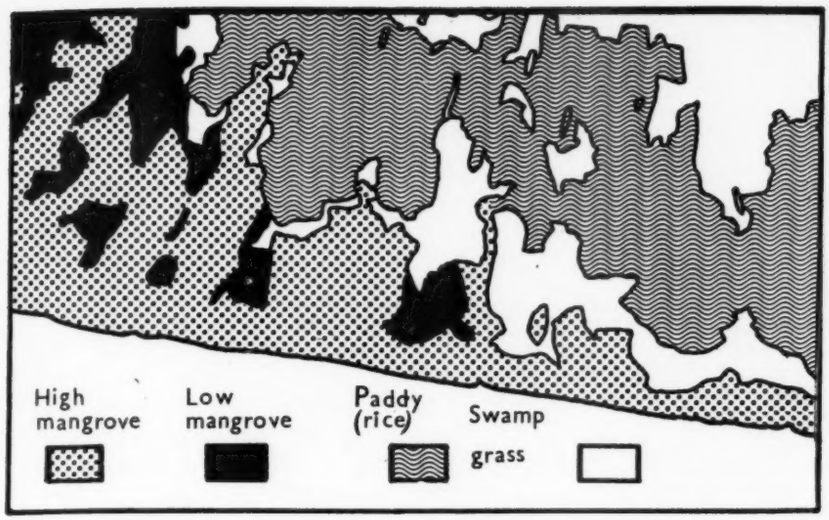
The boundaries marked in this way on the air photographs are then transferred to maps using the conventional techniques, previously described in WORLD CROPS, 1961, **13**, 346. These boundaries may relate to geology, land forms, soil, vegetation or present land use, depending on what aspect of the environment is being studied. This work should result in the accurate placing of boundaries on, say, a 1 : 50,000 map.

Reconnaissance surveys usually commence with field traverse work, the information gathered being recorded against vehicle mileages. These are subsequently plotted on maps or print laydowns and boundaries are then extrapolated from this information, the individual air photograph being used to extend boundaries in places of uncertainty.

Some examples

It will only be possible to describe a small part of the diverse work of the Directorate chosen to show in particular how surveys are applied to help agricultural and forest development.

In the tropics information about the areas of crops grown, particularly by peasant farmers in remote areas, is often scanty or non-existent. These



Gambia. A section of the map, scale 1 : 25,000, which was produced from the air photographs of the hinterland of the Gambia River

are some of the main areas where agricultural development is being vigorously pursued today and lack of such information could be a serious handicap in planning.

Crop mapping

Gambia

The Government of the Gambia asked in 1956 for a survey of some 2,000 sq. miles of central Gambia to be carried out to determine in the first instance if there had been a net change in the acreage under rice in the post-war period. Development of rice growing in the colony had been a major part of Government agricultural policy, but the claimed successes were being challenged. Further information was essential in order to determine future policy.

R.A.F. air photographs taken in 1946 were used to map the rice cultivation in that year, while special photography taken in 1956 was used to determine the change in cultivation. The results were presented in map form at 1 : 25,000 scale. Acreage measurements were made from the maps, which showed a net increase of over 100% in the rice-growing area in the 10-year period. It should be noted that the use of air photography was the only way of making this historical assessment.

This survey also showed the distribution of the mangrove vegetation, which can be used as a very valuable guide to the rice-growing potential of the area. The writer has previously described this aspect of the work (see WORLD CROPS, 1961, **13**, 175).

St. Kitts and Nevis, West Indies

Once again basic statistics about the areas of natural vegetation and major crops were lacking and were required to provide a factual foundation for development planning. In this case the production of these land use statistics coincided with new mapping of the island. The value of the resulting land use statistics will be appreciated from the fact that when they were collated it was discovered that the old figure for the size of the island of Nevis was 28% too high!

Soil surveys

Anambra-Do area, Eastern Nigeria

This particular area was first selected as being a potential sugar-cane area worth further investigation. It also appeared to be under-developed and a possible area for land settlement. A soil survey was proposed (it is now well advanced), preceded by a reconnaissance survey so that soil survey field work could be concentrated in the areas most worth investigating.

This reconnaissance was carried out at the Directorate, using 1 : 25,000 air photography of the area taken by the Nigerian Federal Survey Department. It was possible to show on print laydowns specially constructed for the work (adequate map cover being non-existent) the distribution of the main geological, land form, soil and vegetation types with an obvious saving in time spent on field work later on.

Vegetation mapping

Kenya Highlands

In Kenya there are strongly marked differences in climate within relatively small areas and because of the small number of meteorological stations these differences are not fully appreciated. They are often reflected in the natural vegetation. Thus, if an accurate vegetation map can be compiled, a form of climatic map has also been made. The Kenya vegetation survey has been planned with this in mind. The vegetation units used—natural climax communities — have been chosen so that the climatic differences will be emphasised.

When the vegetation survey work is finished it is intended to correlate the result with the available meteorological data and also with a record of the present successful land use. By combining the three lots of information it is thought that a reasonably reliable indication will be given of the agricultural potential of the country.

This survey of 42,000 sq. miles is now being carried out for the Kenya Government by the East African Agricultural and Forestry Research Organisation working in conjunction with the Directorate. The results will be presented in map form at 1 : 250,000 scale, accompanied by a memoir.

Forestry mapping

Forestry problems are often inextricably involved in agricultural planning; so much so that it is not out of place to mention some of the Directorate's work in this sphere.

Western Region, Nigeria

With increasing population pressure the demand of agriculturists for forest land grows greater. Clearly a factual account of the timber resources and needs of the community must be made so as to arrive at fair solutions of problems of this kind. Broad surveys of the areas of forest, of unused savanna suitable for reafforestation and so on have accordingly been made.

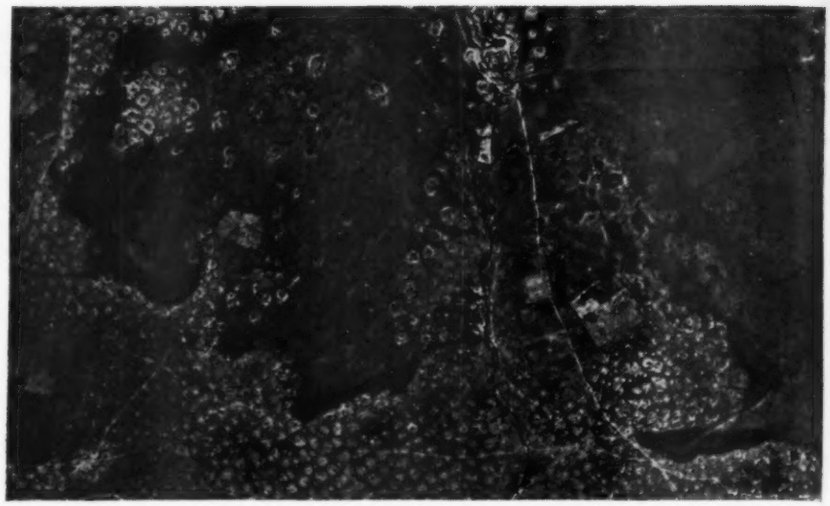
Sarawak

Mapping forest species can be most effectively carried out using air photographs, as has been done for nearly 7,000 sq. miles of jungle country in Sarawak. Such work is, of course, preparatory to more intensive exploitation of the forests, but will be equally useful in years to come, when

the inevitable population pressure requires that more and more forest is taken over for agricultural purposes.

Solomon Islands

Occasionally, certain interesting species of tree can be identified on air photographs. The Solomon Islands are covered by tropical rain forest, consisting of hundreds of species, but one commercial timber, *Terminalia brassii*, grows in sufficiently pure stands to be recognised on air photographs. The distribution of these stands has been mapped on print laydowns preparatory to exploitation. This is of enormous value, as anyone who knows the difficulties of working in tropical rain forest will appreciate.



Kenya. The savanna country is easily distinguishable in air photographs from the grass plains on the black cotton soil

Pilot investigations

Apart from carrying out major surveys, such as the ones described, a number of pilot investigations into the feasibility of using air photography to investigate particular problems are carried out every year for overseas governments.

Each year, too, a certain number of students are trained in the relevant techniques. Expatriate officers going abroad to work in the forestry and agricultural fields attend courses, whilst overseas officers from Africa, the West Indies, the Far East and the Commonwealth generally come to the Directorate for specialist training.

Another aspect of the Directorate's work of special interest to agriculturists is the reproduction of specialist maps for agricultural purposes, which are the products of other scientists working for overseas governments.

Summary

Thus, as well as providing a basis for the production of topographic maps, air photographs are of immense use to workers carrying out surveys of the natural environment for agricultural purposes. Neither the use of air photographs nor the carrying out of these specialised surveys will answer all the agricultural and forestry problems of the tropics. The use of the photographs, however, will usually speed up the surveys and reduce the cost, and the survey will prevent mistakes being made in development programmes.

Letters to the Editor

(*Continued from page* 388)

subject. It is indeed small wonder that livestock poisoning has not become a more serious problem.

To ban the use of sodium arsenite is at best a negative approach. A more positive solution would have been to arrange for the training and licensing of contractors and operators, to ensure by legislation the adoption of minimum standards and patterns of equipment and to introduce a licensing scheme for operators. This might then be followed by a gradual increase in duty on sodium arsenite designed gradually to persuade the planter to turn to cheaper alternative products, yet retaining this well-tried material for use where circumstances warrant it.

C. WHITEHEAD.

'Merrilea',
Swan Lane,
Edenbridge,
Kent.

Water Against Frost

Irrigation has saved potato crops in Britain from major frost damage when temperatures dropped below freezing point. It is reported that a Staffordshire farmer has achieved 90% protection for 18 acres of potatoes while neighbouring crops were severely damaged when ground temperatures dropped to 22°F and the air temperature was 29°F.

This high degree of protection was obtained by irrigating continuously on the preceding days at the rate of $\frac{1}{3}$ in. of water at each application. At 6 acres a day it took three days to irrigate the whole area.

This method of frost protection is not a new idea, but there has been little opportunity in recent years to test it on a field scale because the weather has not been severe enough. As it appears to have been almost completely successful, farmers who have installed irrigation equipment can use water as an efficient means of frost protection. The idea of irrigating before the frost strikes is that when the temperature drops below freezing point, heat is released from the soil, thus keeping the frost from the leaves.

Agricultural Aviation—2

(*Continued from page* 390)

I.A.A.C. organises international conferences and working parties in this field and issues a journal entitled 'Agricultural Aviation'. This journal is now in its third year of publication. It is the only technical scientific journal in this field in the world and has a worldwide circulation.

AIRCRAFT FOR AGRICULTURE—2

The Choice of an Agricultural Aircraft

R. J. COURSHEE*

The author goes on to analyse the factors which determine the cost of aerial operations and concludes that for small fields the autogyro is probably the cheapest way of applying agricultural chemicals and fertilisers.

The effect of land, load and take-off time with different payloads

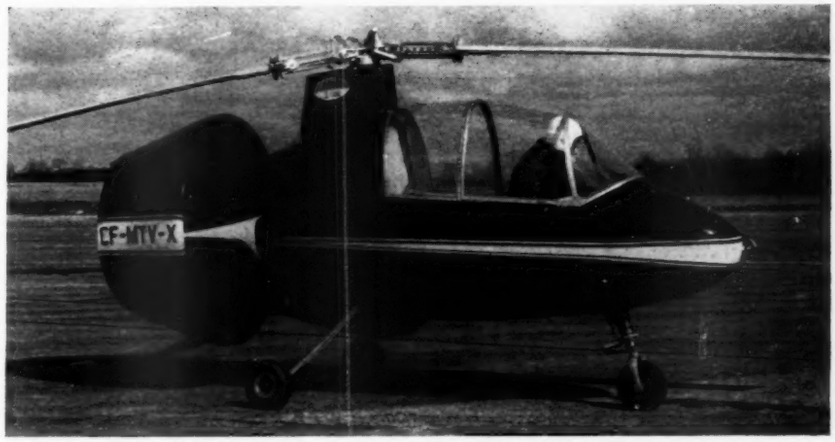
To consider the effect of different payloads, let all factors except payload remain unaltered. The time for these is 48 sec. per acre in the example. Then Fig. 4 may be drawn for this average size field to show how larger payloads decrease the total operating time.

It is clear that as the time taken on re-loading and take-off can vary over the range 60-300 sec., as quoted, it is important to pay attention to these factors, but their importance should not be over-rated. Thus for a helicopter landing in the treated field, which can land, fill and take off in one minute, a large payload for more than four acres is of negligible value. It is only with an aeroplane with a long, slow land and take-off that a payload for a few extra acres is of any value. The converse is equally worth emphasising: if frequent landings are made, they must be made quickly.

If a rotary wing aircraft can land and reload quickly, as it can if it is able to take off vertically in a corner of the treated field, then it need not carry a large payload—enough for a few acres is quite sufficient. Then small and possibly cheap helicopters or vertical take-off autogyros are suitable for the work to be done.

Flying speed and field size

A rotary wing aircraft also permits a low operating speed and for spraying a low speed is desirable. The hypothetical time study also shows that a low speed is acceptable economically, despite the fact that most people have the idea that the aeroplane is valuable chiefly because it flies so fast and covers the ground so quickly. In 10-20-acre fields this characteristic of the aeroplane is of small importance; in fact, a modern duster on the ground will often work as quickly as an aeroplane.



Second prototype of the Avian 2/180 Gyroplane is now flying and limited production is planned late this year. The first prototype was damaged beyond repair during taxi-ing tests last year and a new airframe, incorporating certain components of the prototype, was built.

When an examination is made of the effect of flying speed it is found that very slow flying is quite suitable, providing the effect of wind on a slow-flying craft does not cause difficulties.

To consider the effect of flying speed, let all the factors except for flying speed and field length remain unchanged and see the effect that these have in the above example. The result is shown in Table 1 for three typical field lengths and four flying speeds.

It can be seen firstly how important field size is. A small field increases the time to turn and the time to travel 2,000 yd. to the next field, so that the total time required is near 100 sec. per acre. Small fields handicap the very slow speed aircraft, particularly since this requires 50 sec. per acre merely to travel from one field to the next. However, the faster aircraft takes a long time over its numerous turns—69 sec. per acre. Both this turning time and also the transit time are reduced with the longer runs possible on larger fields. Then the restricting factor on speed of work is the time required for spraying—34 sec. per acre for the 10 yd. per sec. aircraft. However, both on the large field and also on a 16-acre field it is still the slow 20 yd. per sec. aircraft which does the work most quickly. The difference between the speed which results in quickest work and that which results in the slowest is, however, only 20 sec. per acre on a 36-acre field.

For fields of these sizes reasonably close together, say 1½ miles, there is no economic reason to fly faster than 20 yd. per sec. But it is important to operate with short hauls from field to field, especially if the average field size drops below 10 acres. There are

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Table 3

Operating times in seconds per acre

Factors	*Field size 4 acres L = 140 yd.*				*Field size 16 acres L = 280 yd.*				*Field size 36 acres L = 420 yd.*			
V	40	30	20	10	40	30	20	10	40	30	20	10
Go to fill $\frac{T_2}{N} = \frac{2D_1}{VN}$ ..	2.5	3.5	5	1.0	2.5	3.5	5	10	2.5	3.5	5	10
Filling $\frac{T_1}{N}$	15	15	15	15	15	15	15	15	15	15	15	15
Spraying $T_3\frac{4840}{SL} = \frac{4840}{SV}$	8.6	12.9	17.2	34.4	8.6	12.9	17.2	34.4	8.6	12.9	17.2	34.4
Turning $T_4\frac{4840}{SL} = V\frac{4840}{SL}$	69	52	34.5	17.2	34.5	26	17.2	8.6	23	17.2	11.5	5.7
Transit to new site $\frac{T_5}{L_2} = \frac{D_2}{VL^2}$	12.4	16.5	24.8	49.6	3.1	4.1	6.2	12.4	1.4	1.9	2.8	5.6
Total operating times ..	107.5	99.9	96.4	126.2	63.7	61.5	60.6	80.4	60.5	60.5	51.5	70.7

also practical reasons for flying as slowly as this in a country with small fields, many obstacles and bystanders.

Overall costs per acre

A summary of the effects of annual costs and hourly work rates is shown in Fig. 3 (see Part 1) for this example and the range of values found for varying circumstances is given in Table 3.

It can be concluded, firstly, with the example of costs in Table 1, aerial treatments of any sort are relatively expensive and they increase in direct proportion to the time taken to treat one acre. However, it should be possible to hold the time per acre below 100 sec. even with a low flying speed and a small payload to cover, say, four acres. But it is essential to keep the work moving on by making all operations speedy and, even more important, by having detailed plans for moving from one field to the next and by having ground crews ready and waiting

Secondly, one can then visualise costs coming between 10-20*s*. per acre. These are still a little higher than ground machine operating costs, so it is necessary to demonstrate to the farmer that there are other advantages, for example, the avoidance of wheel damage through aerial treatments, to justify the operation economically.

Finally, this limited treatment of the cost of the work is given to show that a low speed—between 10-20 yd. per sec. —is economically acceptable, providing, of course, that such a low speed is acceptable to the pilot. This conclusion allows me to develop three technical points which may become important to agricultural aviation in Europe: a granular distributor for slow-flying aircraft; low flying to spray thoroughly and to help avoid drift, and slow flying to help further to avoid it when applying liquid sprays.

Factors in granule distribution

Granules of pesticide or fertiliser are normally distributed from the air by causing air forces generated by the passage of the plane to propel the granules laterally so that they spread and cover a suitably wide band of the ground. These venturi distributors are often not sufficiently accurate for European agriculture. Moreover, because they ought to be set empirically with great care, they may have been responsible for some complaints which have been expressed about the inaccuracy of such applications. They work best at fairly high flying speeds, *e.g.* 40 yd. per sec.

It has been clear for some time that some mechanical and sure propulsion of the particles is needed to avoid their faults, and this would also allow low flying speeds. Recently the N.I.A.E. made and tested a spinning disk distributor and obtained results similar to those in Fig. 2 (see Part 1). With this distributor granules can be propelled over the target area with a fairly sure aim, independently of wind speed and flying height, providing these do not assume extreme values, and it works well at flying speeds as low as 15 yd. per sec.

Factors in spray distribution

Spray drops, on the other hand, are far less controllable in their flight to where they are required. This is because when they are released below an aircraft 10 ft. above the ground they are blown sideways by a combination of wind and downdraught. The extent of the sideways spread is about two wing spans or rotor diameters for conventional drop spectra and flying heights. However, Reed[4] has suggested

and Akesson and Yates[5] have demonstrated in practice that the path followed by the drops is complexly dependent upon several factors.

Accordingly, this drift type of spraying causes the distribution of pesticide to be erratic and a little unsure. The mean deposit densities can be adjusted to a required level, but the fluctuations about the mean are considerably wider than they are for a ground machine. This drifting spray is also likely to be moved by the wind or by the wing tip vortices and to cause appreciable losses and hazards from down-wind contamination of an adjacent area. With certain pesticides this contamination should be avoided.

If the nozzles are very close to the crop—say, a foot or two—the sideways spread of the drops of spray is almost prevented and at the same time the drift is considerably reduced. This results in a distribution across the swath width, which is more regular, but now the swath is no wider than the boom length. This is usually less than a wing span. Since the working rate, while spraying, is then directly proportional to the boom length, a longer boom would have to be fitted to obtain a high working rate.

It has not been found in practice that the erratic distribution achieved by drifting the spray is less effective than the regular distribution characteristically obtained when using a spray boom. However, the failure to prove that a deficiency results from erratic distribution may signify either that there is no deficiency or, equally, that existing methods are not sensitive enough to detect it.

An erratic distribution must, however, be a little less effective. Also drift spraying certainly gives rise to spray drift. Therefore, really low flying to avoid drift seems desirable and this may be safe among hedges, but only at low speeds. Since there seems to be no economic obstacle to slow flying and since it can only introduce advantages, it should be acceptable if only there were a cheap rotary wing aircraft available and safe to fly with the nozzles less than a yard from the crop.

The present high cost of helicopters might be avoidable, however, either by buying cheap helicopters or, more probably, the simpler autogyros which are reappearing on the market in the U.S.A.

Spray drift

If an aircraft flies with nozzles more than about 4 ft. from the crop, much of the spray of conventional drop sizes drifts down-wind from the track to a distance controlled by wind speed and other factors. Weedkillers have drifted in this fashion and caused, on occasion, spectacular damage which has received public attention.

In trials of this effect[6] the author has found that at a height of 4 ft. and with a light breeze blowing, the largest drop size to travel more than 12 yd. down-wind was 200μ in dia. More recent trials have shown that at a height of 2 ft. only drops 100μ and smaller manage to drift that far, and consequently the amount of drift is considerably reduced by flying close to the ground. There is often several times as much spray in the size range 0-200μ as there is in the range 0-100μ. To avoid drift entirely it is necessary to make sure that there are no spray drops of the sizes which are liable to become drift, *i.e.* no spray drops smaller than approximately 200μ in the spray; the exact size depends upon the circumstances.

The immediate consequence is that the spray is coarse and the spray cover correspondingly sparse. Accordingly, the only pesticides which are of any use for aerial work by this criterion are those which are effective with a sparse cover. These are the systemics, those chemicals which are redistributed externally to the plant, and finally those where the form or behaviour of the pest being attacked

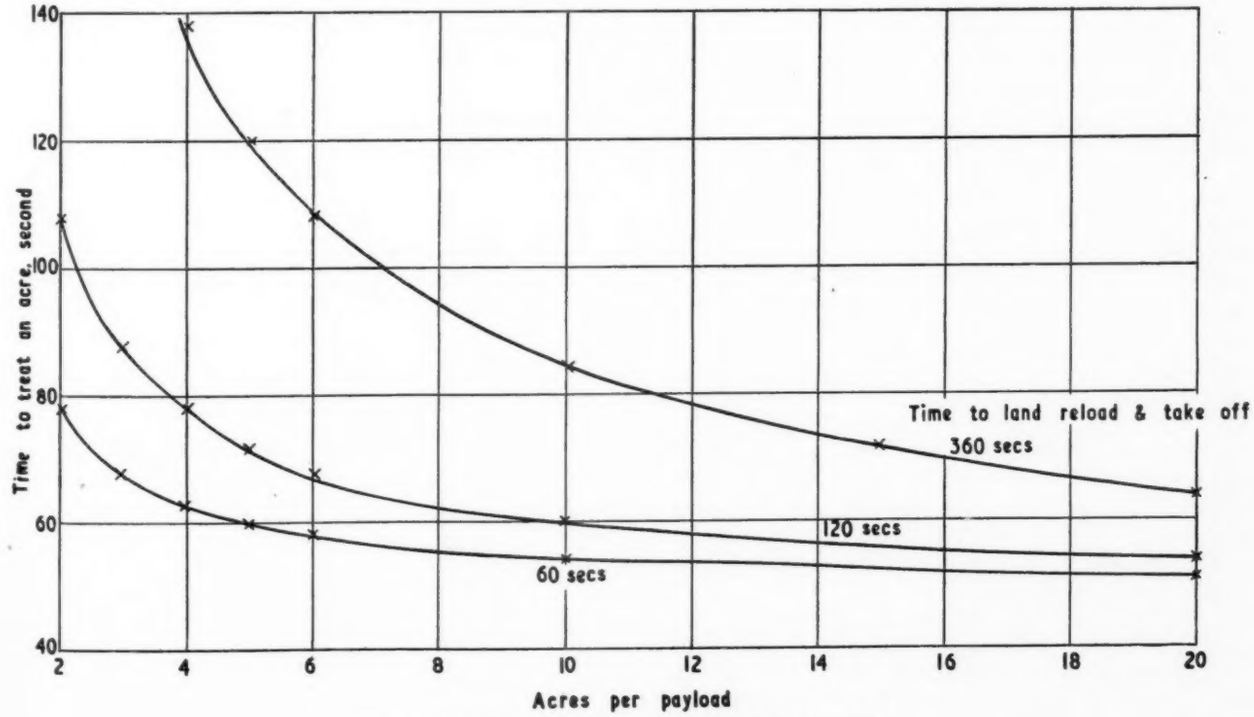

Fig. 4. Treatment time versus payload and reload time

This neat little autogiro is named the Saalfield 'Skyscooter' and can be bought direct from the manufacturers as a complete aircraft or assembled at home from a kit, or built from a plan using your own materials. The 'Skyscooter' has an overall length of 10 ft., a ceiling of over 12,000 ft., a maximum speed of 85 m.p.h., a cruising speed of 65 m.p.h. and a range of 250 miles. The makers claim that it will not stall or spin and will descend safely in autorotation from any altitude with power on or off.

Photos: Air Pictorial

enable it to be controlled with a sparse cover in the absence of redistribution.

But this is taking the most cautious viewpoint. If pesticides which are harmless are sprayed, then there is no problem if a small amount strays into the wrong field. On calm days fine sprays and dusts can both be used without drift occurring and the advantages of a dense spray or dust cover on the crop can be obtained.

In fact, a very great deal of American agricultural aviation is concerned with applying dusts, which are so convenient because of the small load which needs to be carried. Providing it is possible to wait until there is little wind, the application of even poisonous materials as a fine spray should cause no harm.

It is essential to be able to work in a light breeze and this requires the use of pesticides which are neither toxic nor obnoxious or else it is necessary to use coarse sprays or granules.

The granule distributor has already been considered. Coarse sprays—quite devoid of small drops—can also be obtained. To avoid small drops it is essential to stabilise and then control the process of atomisation and to reduce to a minimum the influence of the aircraft slipstream. So a stabilising additive is incorporated in the spray at a cost of a few pence per gallon and the spray is aimed rearwards to leave the nozzle at a speed close to that at which the air is going past the nozzle.

It is necessary, also, to avoid turbulence both in the spray liquid and in the air. For this the operating pressure must be little more than an atmosphere even if a stabiliser has been added to damp out turbulence. Accordingly, the slipstream speed can be little more than the speed corresponding to a spray pressure of one atmosphere, *i.e.* 15 yd. per sec.

Thus there is one more reason for flying at this low speed. At higher speeds it has not yet been found possible to avoid small drops, though at any speed aiming the nozzle backwards at the corresponding pressure helps to coarsen the spray and reduce drift. To avoid air turbulence it is necessary to fit suitable nozzles.

Effectiveness of aerial spraying

Although high costs and the risk of drift are obstacles to more widespread aerial spraying, a criticism which is also voiced occasionally is that for a given expenditure on pesticides aerial applications are often slightly less effective and less reliable than those from a ground machine.

Obviously, some of the pesticide applied from an aeroplane does leave the sprayed field and thus is wasted. Also on many tall and dense crops the aircraft spray or dust is mainly on the tops of the leaves and on the tops of the plant. This form of distribution can, of course, be advantageous, as, for example, against leaf spot on bananas. But it can also cause inefficient results, as it often does on hops against mildew when using copper oxychloride. Clearly, if the material is required on those parts of the plant where the aeroplane is incapable of putting any material, then inefficient results will arise unless the pesticide is subsequently redistributed to those parts of the plant which were unprotected by the original application.

The systemic insecticides, particularly against aphids, illustrate strikingly how effective such redistribution can be inside the plant. The evidence for external redistribution in the liquid phase is much less certain, although redistribution by vaporisation is often readily detectable.

The cover achieved with aeroplanes is incomplete and so it is essential to be able to rely on this redistribution when it is needed. We may not be justified in doing so at present with some of the pesticides which are in widespread use, and there is considerable need for more evidence to show which examples of plant protection are most suitable for agricultural aviation and which justify the relatively high costs of the method.

Some conclusions

For several reasons low and slow flying seem to lead to a type of aerial application which is more suitable in European agriculture than the more extensive type of aerial operation which is used in large countries. If this is correct, then rotary wing aircraft are more necessary here.

Once these aircraft are accepted, then it is not necessary for them to have very large payloads. A small autogyro can land, reload and take off again quickly enough so that it does not have to carry more than is sufficient for just a few acres. A small aircraft cannot carry more than a two-acre payload when applying fertilisers, so it is desirable for it to reload quickly in the treated field in order to cut transit times. Accordingly, this machine should be capable of vertical take-off under load and therefore requires a mechanical drive to the rotor and also a collective pitch control. It is therefore a more expensive machine than the basic autogyro, but it should be far less costly than a helicopter. In exchange for this economy we have to use a machine which requires air speed to stay in the air.

The simple autogyro without jump-start equipment requires a short landing strip just like a monoplane, and so it should carry a somewhat higher payload than a vertical take-off aircraft. A spray payload for 10 acres weighs only about 200 lb. and 10 acres is sufficient to reduce a 3-min. reload time to a negligible level. This aircraft is then limited to two acres when applying fertiliser at 100 lb. an acre. Whether this is a more valuable type of aircraft

(*Continued on opposite page*)

Industrial Crops in Czechoslovakia

THERE has been some increase during recent years in the production of cash crops in Czechoslovakia. *Sugar-beet* is the leading crop and this country is now one of the main producers and exporters of beet sugar in Europe.

The crop is grown on about 600,000 acres in medium warm regions, where it occupies up to a fifth of the available acreage of arable land. The sowing of single-sprout seeds and the use of selective weedkillers are being introduced and mechanised thinning and harvesting are being increasingly practised.

Flax growing, which was on the decline between the two world wars, is providing a good source of income for co-operative farms in upland and hilly regions; about 125,000 acres are now under this crop. Thin-stemmed varieties with a good yield have been introduced, as well as the use of chemical weedkillers and harvesting combines, which in one operation cut off the seed pods, pull the stems and lay them out on the ground to dry.

In recent years, the simultaneous sowing of Italian ryegrass has become popular. The grass does not seed, as the flax overshadows it, but it creates a good grassy base for direct dew irrigation. It also helps to consolidate the soil and so makes it possible to harvest with heavy machines.

Workers at the Caslav State Farm use nylon nets for loading sugar-beet

Hemp was formerly grown in many districts, but the area has been reduced because of competition from jute, sisal and synthetic fibres. The crop is now restricted to Southern Slovakia, where there are processing facilities; both flax and hemp seed provide raw materials for the production of vegetable oils. The possible usefulness of hemp in the pharmaceutical industry is being studied.

The most popular crop in the oleaginous group is winter *rape*. Between the wars this crop was neglected, but now there are more than 140,000 acres and the area is being extended. Yields have increased substantially during the past 10 years due to earlier sowing, more effective control of pests, the use of fertilisers and of improved thresher-mowers for harvesting.

Slovakia's main oil-bearing crop is, however, *sunflower*, some 15,000 acres of which are now under cultivation, and the area is increasing. Early-maturing varieties are being introduced and mechanised harvesting is being developed.

There is also *poppy seed*, which is exported to Western Europe and the U.S.A. In 1959 a new hybrid was introduced and fresh seed is prepared each year by the hybridisation of the parent plants. The poppy crop is liable to damage by sporadic outbreaks of disease, but it is a popular crop which is important to the pharmaceutical industry, which processes the dry, empty pods for the production of opium.

Other crops are white and black *mustard seed*, *paprika* (cultivation of which has tended to increase) and *tobacco* (with a declining acreage).

Aircraft for Agriculture—2

(*Continued*)

for the work than the monoplane still remains to be proved.

It is interesting to conclude with the thought that rotary wing craft of elementary form are cheap by aeronautical standards, and yet they are probably suitable for special work, and so the costs shown in Fig. 3 may be reduced in the not too distant future. Moreover, even at present costs, aircraft probably provide a cheaper way of applying spray and fertiliser chemicals if the hidden costs of taking a wheeled vehicle into a crop are taken into account.

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Cocoa Trees in the Solomons

The millionth cocoa tree was planted in the Solomon Islands during the first quarter of 1961 and cocoa farmers there are beginning to reap the benefits of their plan for expanding the crop. During 1960 seven tons of cocoa were produced on Malaita; this compares with the seven bags produced on the same island in 1958.

The policy of selecting the widest range of seed from local materials is being continued and introductions have been made from Rendova, Guadalcanal and Santa Cruz. Cocoa and chocolate manufacturers have been quite satisfied with the standard of samples received from the islands—the degree of fermentation is adequate and the flavour satisfactory.

A FARMER'S BEST FRIEND IS A FORD ENGINE

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World News

Southern Rhodesia

Rain to Order

On the banks of the Lundi River in Southern Rhodesia a vast area of virgin bush country has been cleared for sugar-cane and citrus. This ambitious project, which will eventually entail irrigation of over 10,000 acres by means of canals and overhead sprays, is being undertaken by Hippo Valley Estates. Already 30,000 citrus trees are growing on land which only a few years ago was the home of lions and elephants.

The main contractors for the pumping equipment, *Triplejay Equipment (Pvt.) Ltd.*, have installed two 540-h.p. eight-cylinder diesel engines, coupling them to *David Brown* 17-in. wide-type helical gearboxes to increase the speed of the two *Mather & Platt* pumps which, working in parallel, will deliver 7,500 gal. of water per min. at 360-ft. head.

The main water supply pipe is four miles long, with tapping points over the whole of its length to carry water to the areas under irrigation. For the first quarter of a mile, the pipe is 24 in. in dia., progressively reducing to 12 in. Overhead sprays, spaced 180 ft. apart, operate at a pressure of 80 lb. per sq. in. This gives the equivalent of 8 in. rain per month, which is required for growing sugar-cane.

New Caledonia

Technical Meeting on Co-operatives

Training and education in the field of co-operation in the Pacific, and the part that co-operatives in the area can play in capital formation, were the two main topics discussed at the second technical meeting on co-operatives held at the South Pacific Commission headquarters in Nouméa.

Representatives from 10 Pacific territories attended. FAO was represented by its specialist in agricultural co-operation and by a consultant specially appointed for the meeting. Observers for the Governments of Australia, the U.K. and the U.S.A. were also present.

The meeting first considered a variety of problems associated with training and education in the field of co-operation—the training of staff of government co-operatives departments, the training of directors, office bearers and employees of co-operative societies, and the education of members. Special attention was also given to the whole question of co-operative education within the community generally.

The meeting then studied in detail the role of co-operatives of all kinds in stimulating higher levels of saving and investment in Pacific island communities, particularly in relation to the acquisition and maintenance of productive equipment, such as trading vessels, trucks, tractors etc. Special attention was given to the organisation of thrift and credit societies by co-operatives to provide capital for productive loans.

Seychelles

Cattle on Coral Island

An experiment in the Seychelles has shown that cattle can be successfully reared on coral islands. This has hitherto been thought to be impossible owing to the high percentage of calcium carbonate (90%) which is found in the soils of such islands, but at Farquhar Island in the Indian Ocean a herd of 25 head of cattle has been raised successfully by supplementing the cattle feed with 'Churn' Protective Mineral No. 105, imported by the Department of Agriculture.

Cattle are needed on these islands to supply meat and milk and also manure, which can be used to enrich the soil for coconuts and garden crops.

South Africa

World Record?

From South Africa it is reported that a record sugar-cane crop has been obtained in a trial on the lands of the Government irrigation scheme at Pongola. A yield of 333.6 tons of cane per morgen (1 morgen = 2.117 acres) has been obtained following the application of 2 tons of reno phosphate rock with 4 tons of a 15 : 0 : 15 fertiliser mixture applied at fortnightly intervals when the crop was 21 months old. The variety of cane which gave this formidable tonnage was one of the POJ varieties which prior to the war had been discarded as being unsuitable. The trial is being repeated in the form of a competition and with co-operation from the Mount Edgecombe Sugar Experiment Station. This high yield is a world record so far as is known.

Czechoslovakia

Millions of Fruit Trees

Last year was a good year for apples in Czechoslovakia, where the crop contributed handsomely to the 200,000 tons of fruit produced. There were nearly 20,000 tons of apples in excess of expectation and the subsequent output of apple juice was 50% higher than planned.

Czechoslovakia now has 47 million fruit trees, a third of which are apple trees. About 21,000 acres of orchards have been planted in the last five years alone. This planting is to be extended and the number of trees to be increased by about a quarter again between now and 1965. One aim is to raise the amount of fruit consumed annually from 125 lb. to 176 lb. per head.

Kenya

Agricultural Progress

Considerable progress in improving farming methods in Nyanza Province has been reported. At the end of 1960 some 316,000 acres of fragmented land holdings in the province had been measured, redistributed in the form of workable plots and enclosed. Farm layouts have also been prepared in several districts by the staff of the Agricultural Department, and the consequent steady improvement in the production of cash crops is strengthening the economy of the area.

England and Wales

Agricultural Machinery Census

The results of the census of agricultural machinery in 1960 shows that the number of powered machines used on agricultural holdings is more or less the same as in 1959. Wheeled tractors over 10 h.p., 353,600; crawler tractors over 10 h.p., 16,130; one and two-wheeled power machines, 46,990. Total 416,720.

Coming Events

Industrial Chemistry. — The 33rd International Congress of Industrial Chemistry will be held in Bordeaux from 1-8 October. One of the 23 sections will be devoted to agricultural science and the food industry. Information may be obtained from the Société de Chimie Industrielle, 28 rue Saint-Dominique, Paris VII, France.

Aerosols.—The third International Congress organised by the Federation of European Aerosol Associations will meet in the Congress House, Lucerne, Switzerland from 4-6 October. Further information, including programme and application forms, are available from the International Aerosol Association, Waisenhausstrasse 2, Zurich 1, Switzerland.

The first International Aerosol Exhibition will be held during the period of the Congress and for a further two days at the Kurst-und-Kongresshaus, Lucerne. Further information may be obtained from A. Wettler, c/o Pluss-Staufer A.G., Oftringen, Switzerland. The exhibition is open to the public and admission is free.

Forest Genetics and Tree Breeding.—To further the aims of the FAO World Seed Campaign, the Forestry Commission will hold a course on forest genetics, tree breeding and seed production at Northerwood House in the New Forest, Hampshire, from 9-13 October. Enquiries to: Chief Education Officer, Forestry Commission, 25 Savile Row, London, W.1.

Vines. — An International Vine Growing and Wine Fair will be held in Montpellier from 12-22 October. Further details may be obtained from Foire Internationale de la Vigne et du Vin, 11 bis rue de Loge, Montpellier, France.

Timber.—A Timber Fair will be held at Dusseldorf from 20-29 October. Details may be obtained from Nordwestdeutsche Ausstellungs - Gesselschaft m.b.H. (Nowea), Messegelande, Dusseldorf, W. Germany.

Agricultural Chemicals.—The 28th Annual Meeting of the National Agricultural Chemicals Association will be held from 29 October-1 November at The Homestead, Hot Springs, Virginia, U.S.A.

Water Treatment. — The second Effluent and Water Treatment Exhibition and Convention will be held in the Seymour Hall, London, from 31 October-3 November. Enquiries to the Exhibition Press Officer, 2 Broad Street Place, London, E.C.2.

Weeds.—The Annual Weed Conference is to be held by the Washington State Weed Association on 6-7 November. Further information from the Washington State Weed Association, Chinook Motel and Tower, Yakima, Washington, U.S.A.

Insecticides and Fungicides.—A conference on insecticides and fungicides will foregather in Brighton from 7-10 November. The conference is sponsored by the Association of British Manufacturers of Agricultural Chemicals. Further details from A.B.M.A.C., 86 Strand, London, W.C.2.

Mechanical Handling.—An exhibition of aerial ropeways, earth-moving equipment, static and mobile cranes, trucks, conveyors, elevators, grain, powder and chemical handling plant and bottling plant will take place at Earls Court from 8-18 May, 1962. Further details may be obtained from H. A. Collman, Exhibition Manager, Dorset House, Stamford Street, London, S.E.1.

Agricultural Exhibitions

Australia.—The Royal Agricultural Show is to be held in Perth from 29 September-10 October. Details from the Royal Agricultural Society, 239 Adelaide Terrace, Perth.

Canada.—The Royal Agricultural Winter Fair will be held at Toronto from 10-18 November. Enquiries to J. R. Johnston, Royal Coliseum, Exhibition Park, Toronto, 2B.

England.—The Royal Smithfield Show and Agricultural Exhibition will be held at Earls Court, London, from 4-8 December, 1961. Further details may be obtained from the Smithfield Show Joint Committee, S.M.N.T., Forbes House, Halkin Street, London, S.W.1.

Holland.—A Farm Machinery Exhibition will be held in Amsterdam from 22-27 January, 1962. Particulars from R.A.I. Gebouw N.W. Europaplein 8, Amsterdam.

Belgium.—An International Agricultural Machinery and Equipment Exhibition is to be held in Brussels from 11-18 February, 1962. Enquiries to Société de Mecanique et d'Industrie Agricoles, 29 rue de Spa, Bruxelles 4.

Libya.—An International Industrial, Commercial and Agricultural Fair is to be held in Tripoli from 20 February-20 March, 1962. Further details may be obtained from Dr. Ali Jazairy, Tripoli International Fair, Giaddat O. Muktar Tripoli, P.O. Box 891, Tripoli.

Verona.—The 64th International Agricultural and Animal Farming Fair will be held from 11-19 March, 1962. Enquiries to Fiera di Verona, Piazza Bra, Verona.

Water Supply Scheme

The Darling River (New South Wales) Water Supply Scheme was officially opened in July. This scheme is an extension of the Menindee Lakes Storages, completed last year, and is designed to replenish water supplies along Tandou and Redbank Creeks and the Great Ana Branch, which lie west of the Darling River downstream from Menindee. Lake Cawndilla outlet regulator was opened and a small flow proceeded into the Cawndilla Channel and thence ultimately to the Ana Branch.

At present only 400,000 acre-ft. of water is held in the Menindee storages, compared with the total capacity of 2 million, and only 35,000 acre-ft. is available from Lake Cawndilla.

The scheme will not come into full operation until substantial quantities of water have been diverted into Lakes Menindee and Cawndilla in the Menindee storages.

New Publications

Soil Biology

Soil Biology, with special reference to the Animal Kingdom by W. Kuhnelt, translated by N. Walker. Pp. 397. Four plates and 77 figures. Faber & Faber, London. 1961. Price 45*s*.

Formerly only a few bacteria and certain animals, earthworms, centipedes etc. were recognised as active soil inhabitants, then it was shown at Rothamsted that protozoa were also active and a small team of workers was set up to study these and other soil organisms, other small animals, algae, fungi and others, so developing the idea of a soil population closely related to the growing plant.

In recent years zoologists have been particularly active and among them Prof. Wilhelm Kühnelt, of the University of Vienna, and his students and collaborators have made notable contributions. His *Bodenbiologie*, published in 1950, deservedly attracted much attention; he has now completely revised it and Dr. Norman Walker has translated it into good readable English, making the book a pleasure to study.

Forest soils have the largest and richest fauna by reason of the food and shelter afforded by the leaves, twigs etc. left on the ground; the various organisms gradually decompose this litter layer and mingle it with the underlying mineral matter, sand, silt and clay, so forming the complete soil, or alternatively peat if there is too much water. The changes effected in building up the soil are not yet fully known, but present knowledge is clearly set out and it makes a fascinating story.

Two main stages are recognised: primary decompositions, usually by the larger organisms, which take out the easily digestible carbohydrates, proteins etc. and disintegrate the residue; and the secondary decompositions, usually by much smaller organisms, including bacteria operating in the gut of the primary decomposers or by coprophagous organisms feeding on their excreta. The final residue, the humus, is mingled intimately with the clay fraction of the soil to form the clay-humus complex, which is of vital importance in soil-plant relationships.

The fauna of pasture soils broadly resembles that of the forest soils, but is more restricted: it lacks certain groups, notably the wood decomposers and the larger forms that can shelter in the litter but not in the grass; the consequences of this curtailment are fully discussed. The fauna of arable soils is still further depleted: much less organic matter is available, the soil is greatly disturbed by cultivation processes and, being without a protective vegetation cover for a part of the year, its upper layers are liable to greater changes in temperature and moisture content.

The book can be strongly recommended to all concerned with the study of the soil. It brings together in an easily assimilable form much valuable information not easily accessible elsewhere. For the agriculturist and soil specialist the book could have been improved by the addition of a general index into which the English names of some of the commoner soil animals could have been inserted. The extensive bibliography, too, would have been more useful if page references had also been given. These, however, are only minor defects which can easily be rectified should the book achieve the success it deserves.

E. JOHN RUSSELL

Forest Fire

By K. P. Davis, G. M. Byram and W. R. Krumm. Pp. 584. Illus. McGraw-Hill Book Co., London. 1959. Price 97*s*.

While this book is published as the joint effort of three authors, the credit must go undoubtedly to Prof. K. P. Davis for his inspiration and tenacity of purpose in compiling under one cover such a great fund of knowledge, statistics and records of practical experience.

Fires in forest land can have very far-reaching effects not only in the material loss of timber, but also on the well-being of the rural community, and with the increase of world population and decrease of the natural reserves of timber the whole subject of fire control has necessarily become a science in its own right.

Hitherto the growing body of students of this science has been at a disadvantage, as records and data on the subject have been dispersed in a very wide and diversified literature. Now for the first time we have a compendium on forest fires set out in a logical and practical sequence and covering virtually every aspect of the subject.

In the typical American manner much use is made of statistics and tabulated statements, but one is not left to interpret these as best one can; they are analysed and discussed in detail and in a remarkably readable manner for a textbook of this nature.

It must be appreciated that this book deals with conditions in the Western Hemisphere, where the forest area is immeasurably greater than in the U.K., and reliable records are available over a longer period of years, but the British forest manager responsible for the fire protection of his area and even moderately versed in forest fire-fighting can adjust the scale of the data to conditions in this country.

A forest fire can be a horrifying experience often leading to panic, and this can be overcome only by a detailed knowledge of all the factors involved. It can be justly said that a textbook of this nature goes a long way towards easing the alarm felt by any forest supervisor in tackling the problems of forest fire protection. It would be interesting to know in future years how many acres of woodland have been saved from destruction by the knowledge and advice set out in this book.

Perhaps the only criticism one can make is that insufficient emphasis is paid to the need for clarity of thought and leadership by those in charge of forest fire-fighting, but *Forest Fire* is not a manual of operations; it is a very valuable and interesting textbook.

G. F. BALLANCE

Agricultural Dictionary

Russko-Angliiskii Selskokhozyaistvennyi Slovar. Compiled by B. N. Usovsky *et al.* Pp. 504. Fizmatgiz, Moscow. 1960. Price 16.05 roubles (approx. £1).

In this Russian-English agricultural dictionary the compilers have produced a useful tool for those who have to (or would like to) read Soviet agricultural literature. As they say in their preface, they 'hope it will meet all the basic requirements of translators,

research workers and agricultural specialists'.

The dictionary contains over 30,000 terms on all aspects of agriculture in the widest sense, as well as kindred subjects, such as forestry, applied zoology, land survey, fish breeding, biometrics etc. Botanical and zoological names are given with their Latin equivalents, and for fertilisers, pesticides etc. the chemical formulae are also given. A list of abbreviations and symbols in general use in Russian agricultural literature is also included.

The fact that the dictionary is not illustrated and contains several misprints and inaccuracies, as well as some unnecessary inclusions and glaring omissions, should not detract from its value as an indispensable *vade mecum* for anyone involved with Soviet agricultural literature. English-speaking people can count themselves fortunate that the Russians have seen fit to produce this dictionary at a time when Soviet technical literature is increasing so much in quantity and quality.

W. LINNARD

The Cork Tree

By G. B. Cooke. Pp. 112. Illus. Pergamon Press, London. 1961. Price 50*s*.

This book is directed to those who make commercial use of cork, to those who wish to use the evergreen beauty of the tree for landscape gardening and to those who wish to widen their knowledge of economic crops.

Where cork grows, how it is harvested, processed and manufactured and principal cork products are discussed and statistics on cork production and trade data are presented.

The Orchard and Fruit Garden

Edited by E. Hyams and A. A. Jackson; photography by E. H. West. Pp. xv and 207. 80 illus. Longmans, Green & Co. Ltd., London. 1961. Price £10 10*s*.

This symposium surveys achievements to date in the cultivation of fruits in the temperate zone. The 33 chapters, written by 25 specialists, are models of accuracy and lucidity. The comprehensive chronological bibliography, general index and index to bibliography are all excellent.

The first two chapters discuss fruit plants in nature and the origin of cultivated fruits, while the third chapter is concerned with an historical survey of fruit growing in Great Britain; subsequent chapters are devoted to propagation and pruning. Each of the well-known fruits grown in Great Britain is accorded a chapter.

The final six chapters deal with aspects of fruit production and export in South Africa, Canada, Australia and America, including special chapters on the lemon and bananas. The editors justify inclusion of information on these tropical fruits on the grounds that they compete with temperate climate fruits, are consumed the world over and are no dearer than our own hardy fruits. One may doubt the justification for inclusion of these exotic fruits in the present volume, but their inclusion in no way detracts from the value or charm of the book.

The reader is told that in producing this book the editors and publishers have borne in mind three considerations: firstly, fruit, with its strong appeal to the eye as well as the nose, palate and sense of touch, deserves to be considered under the heading of aesthetics, and therefore beautifully presented; secondly, this ancient but ever more important branch of agriculture has great social and historical significance; and lastly, it is desirable to present, in plain language and the best possible colour photographs, some idea of the scientific work done since about 1910 in changing the relationship between man and his fruit plants.

The large format of the book has enabled the reproduction of natural-size colour photographs of many fruits discussed; they form a beautiful collection of illustrations.

As an excellent example of modern book production *The Orchard and Fruit Garden* will have a special appeal to the bibliophile; by reason of its accuracy, conciseness and up-to-dateness it will be valued by the fruit grower and student.

Ten guineas may seem a lot of money to pay for a book on fruit growing, but to see this book is to covet it.

D. H. GRIST

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Annual Reports

Rothamsted Experimental Station. Annual Report for 1960. Pp. 329. Obtainable from Rothamsted Experimental Station, Harpenden, Herts, England. Price 10*s*., post free.

The Grassland Research Institute. Annual Report for 1959-60. Pp. 123. Obtainable from the Grassland Research Institute, Hurley, nr. Maidenhead, Berkshire, England. Price 7*s*. 6*d*.

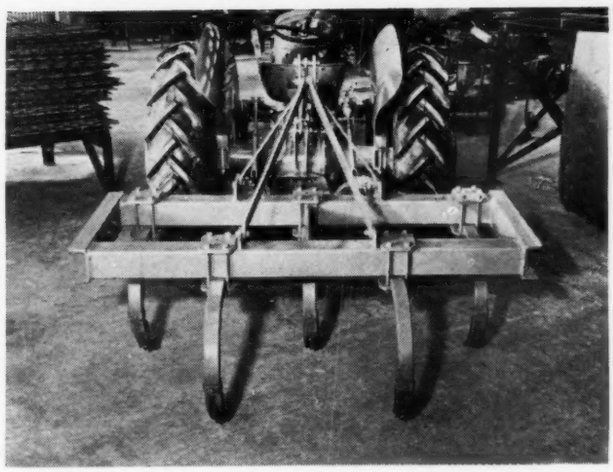
American Tomato Yearbook, 1961. Pp. 44. Obtainable from 8 Elm Street, Westfield, New Jersey, U.S.A. Price $2.

Department of Agriculture for Ireland. Twenty-ninth Annual Report of the Minister for Agriculture, 1959-60. Pp. 123. Obtainable from Government Publications Sale Office, G.P.O. Arcade, Dublin, 1. Price 8*s*. 6*d*.

University of Pisa. Proceedings of the Faculty of Agriculture of the University of Pisa for 1960. Pp. 260. In Italian. Obtainable from the University of Pisa, Italy. Price 25*s*.

Institute for Research on Storage and Processing of Horticultural Produce. Annual Report for 1959. Pp. 60. Illus. Obtainable from I.B.V.T., Haagsteeg 6, Wageningen, Netherlands. Price not stated.

Agriculture, Forest and Fisheries. Annual Report for 1960 of the Department of Agriculture, Forests and Fisheries of Western Samoa. Pp. 45. Obtainable from the Department of Agriculture, Apia, Western Samoa. Price not stated.



Left: *The highly streamlined New Idea maize picker over-mounted on a John Deere tractor.* Right: *The 'Panbuster Cultiplough' may be fitted to the three-point linkage of 40/50-h.p. tractors*

Machinery and Equipment

Tractors and Implements

Tractor-mounted Maize Harvester

New Idea Farm Equipment Co., of America, have introduced a compact maize harvester which can be over-mounted on any type of tricycle tractor. Simple axle brackets are the only parts which will vary from tractor to tractor, and it can be completely mounted or removed in less than 20 min. by two men. Through the extensive use of galvanised sheeting, the drives are completely shielded, and it is easy and safe to get on or off the tractor without stopping the engine.

The implement is designed to pick and husk, or pick and shell two rows of maize and pull a well loaded trailer as well. This highly streamlined unit consists of two guiding units, one on either side of the tractor: a husking unit for separating the cobs from the stalk and leaves, and an elevator for delivering the cobs into the following trailer. The 'New Idea' sheller can be added, so that the cobs can be shelled simultaneously.

Panbusting

Many farmers have found reduced crop yields have been caused by the frequent movement of very heavy farm machines, such as the combine harvester, over the land. This is due to the development of a hard pan over the years, which results in poor drainage and soil aeration.

A new tool has been added to the range of *Brown's Implements Ltd.*—the 'Panbuster Culti-plough'. This is a tractor-drawn rear-mounted implement consisting of five rugged spring tines mounted on a strong steel frame. These tines flex in work, stir up the pan and produce an ideal seedbed for the spring planting.

Friend and Foe

Weeds are a menace in any crop, but they can be used as an aid to good husbandry. In the early stages of plant growth they provide shelter for the young seedlings and may even assist in conserving soil moisture. However, once the crop plant is established, they are a source of competition in the later growth of the plant and will have an adverse effect on yield.

The *Webb* 'Universal' steerage hoe is designed to give accurate inter-row cultivation and mulch the weeds into the soil, thus assisting plant growth by providing additional humus material and holding the soil moisture. This machine is available for four-, five- and six-row hoeing and there is a simple adjustment for varying the width between rows. Each hoe is spring-loaded to compensate for undulations in the ground and in this way an even hoeing depth is maintained. In the latest version a steerable down-the-row thinner has been added.

Sod-seeding

Sod-seeding or 'zero ploughing' is claimed to be the easiest and cheapest way of renewing and improving pastures; except for a brief spell of a few weeks while the seedlings are establishing themselves, there is no interruption to grazing. The system requires no soil preparation and so represents a considerable saving in labour and tractor fuel compared with sowing prepared seedbeds.

Clover-dominant pastures can be sod-sown with ryegrasses or other suitable strains without harm to the existing growth and hill pastures can be sod-seeded on the contour for erosion control and to obtain uniform penetration of the rainfall. Sod-seeding makes very tiny furrows and does not expose any loose soil, so there is little danger of losing valuable topsoil by run-off.

Jeffrey Engineering Co. Ltd. have produced a tractor-drawn implement for sod-seeding which cuts nine tiny furrows in the soil 2 in. wide, 1 in. deep and 10 in. apart. Seed and fertiliser

The J.E.C. sod-seeder introduces seed and fertiliser beneath the sod

are introduced in precise quantities and are immediately covered with topsoil. This system of pasture regeneration has been in extensive use in Australia for seven years.

Versatile Fork-lift

A new fork-lift unit has recently been introduced by *H. Cameron Gardener Ltd.* for mounting on the *Massey-Ferguson* '35' and the *Fordson* 'Dexta', 'Power Major' and 'Super Major' tractors. It is arousing a great deal of interest among fruit growers and market gardeners for handling produce on pallets or bins. It could also be used for handling fertilisers and root crops.

The implement is designed to lift a load of 6 cwt. to a height of 6 ft., which is adequate for one-tier loading on to lorries and trailers. Being a rear-attached implement, it gives added weight to the rear wheels and so allows the equipment to be used even on soft ground.

For Deep Tillage

One of the most interesting implements during the year is the 'Chance' chisel plough, which was designed by a Norfolk farmer and is now being marketed by *Rotary Hoes Ltd.* This implement is complementary to their 'Rotavator' and together they will make a powerful combination.

Harvesting Tropical Crops

The National Institute of Agricultural Engineering recently carried out field trials in Kenya and Uganda to test the *Wilder* 'Multi-Master' forage harvester and assess its ability to harvest, cut and shred tropical and sub-tropical crops and to clear scrub.

The finding was that the machine represents an outstanding advance. The overall rate of work was about 1-2 acres per hour at speeds of 4.5 m.p.h., of course depending on the heaviness of the vegetation and the ground conditions. The machine always worked efficiently without choking and even tall crops like maize 10 ft. high and Napier (elephant) grass 5 ft. high were dealt with without difficulty (*N.I.A.E. Test Report No.* 208).

Multi-purpose Toolbar

The *Rau-Kombi* system is a universal toolbar fitting to the *Fordson* tractor. This is connected to the three-point linkage of the tractor and has six lugs to which the main arm can be attached according to the height required for the job. At the other end of this drawbar there is a supporting wheel and a pan seat can also be fitted. The whole unit can be lifted hydraulically and the supporting wheel need not be fitted.

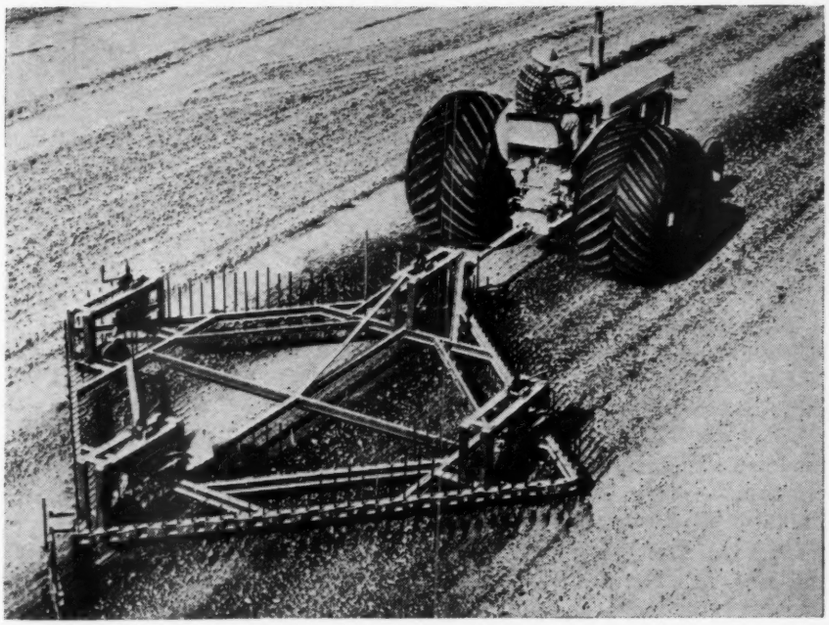
To this basic unit 30 different implements can be fitted, either singly or in combination. For instance, the combination may allow three operations, *e.g.* hoeing, crumbling and smoothing, to be completed in one run; alternatively, a special digger can be attached for lifting sugar-beet.

Teasing the Turf

A tractor equipped with the new

Left: *The Chance chisel plough has five powerful tines.* Right: *The new Cameron 'Gardener' tractor fork-lift unit*

'Terra' tyres made by *Goodyear* is now being used on Hollywood race course in California to pull a huge teasing rake over the turf. The tyres have more than 600 in. of contact with the ground and this broad footprint and an inflation pressure of only 5 lb. per sq. in. ensures that no ruts or depressions are left by the passage of the tractor.



A tractor equipped with 'Terra' tyres that have more than 600 sq. in. of contact with the ground pulls huge rakes that smooth the turf without leaving any wheel marks

Three Versions of Harvester

The *McCormick International* No. 5 harvester is available in three versions: as an auger-blower, a direct-throw model and as a shredder. These are designed for producing green forage, silage or to produce a mulch, respectively.

The auger-blower has 56 double-edged, L-shaped reversible knives mounted on its rotor. These knives flail the standing crop and throw it into the auger, which delivers the cut material to the cutter head, where it is recut into shorter lengths and blown back into the forage wagon.

The McCormick International No. 5 forage harvester cutting a 60-in. swath in beet for silage

The direct-throw model is fitted with 28 cupped knives shaped to cut the crop cleanly and throw it up a tapered chute to any part of the accompanying trailer.

The shredder model has the same rotor knives as the auger-blower, but is fitted with a low hood to deflect the finely chopped material back on to the ground to serve as a mulch.

Forest Tractor

The latest version of the *Bristol* tractor, known as Series P.D., is based on the D model, but the h.p. has been increased from 25 to 32. The final drive has been redesigned and it now has a 10-in. clutch with ball-thrust operation in lieu of the original carbon ring type.

This very useful light tractor is available in a standard version, as a narrow track version for working in confined spaces and also with a broad track to give increased stability on sloping hillsides.

Trailer Pump

Farrows have redesigned their tractor-powered irrigation pump as a two-wheeled trailer and have now arranged the impeller housing so that the discharge outlet is nearer the ground; the outlet can also be turned through 180° to face to the rear.

It is p.t.-o. driven through the new short *Hardy-Spicer* shaft, which is provided with a plastic guard. With a gearbox ratio of 4.25 times the p.t.-o. speed the output is 300 gal. per min. with a 225-ft. head when the shaft is rotating at 550 r.p.m. At this output the power demand is 33 h.p.

Multi-purpose Implement

The *Trojan-Legg* 'Cultograder' is a multi-purpose tillage implement which can be used to replace the plough, cultivator, disk harrow and roller. It can also be used as a sub-soiler for breaking up a hard pan.

It consists of a basic frame fitted with powerful tines and a grader blade. Infinitely variable adjustments are possible, enabling this implement to be used for producing a 10-in. tilth

for a seedbed or for removing hedgerows or excavating silage pits.

It can be used either as a mounted or a semi-mounted implement and a patent hitch produces weight transference to the rear wheel of the tractor —an important point when working in wet or soft conditions.

Four-wheel Drive

Trials have shown that the provision of four-wheel drive in the *Fordson* 'Dexta' will considerably enhance its performance. For instance, it will make it possible for the four-furrow mounted FR plough to be used with this tractor—an implement normally used with the 'Power Major'.

This useful conversion can also be made to the 'Super Major' tractors and 220 of these machines have recently been exported from the works of *Roadless Traction Ltd.* to Finland following previous smaller orders.

The Roadless Traction conversion of the Super Major

More Food for Africa

The *Uganda Co.* (*Africa*) *Ltd.* reports that African farmers are increasingly turning to the tractor to help them open up more land for the cultivation of such cash crops as tobacco, millet, groundnuts and cotton.

In Ghana, too, great interest was shown in the FR rotary slasher for bush control, disk ploughs for primary cultivation, and post-hole diggers for fencing the farms. A series of demonstrations arranged by the local *Ford* distributor, *John Holt Bartholomew Ltd.*, was attended by members of the Agricultural Department and officers of the Agricultural Development Corporation of Ghana.

A Fordson 'Super Major' fitted with an FR rotary slasher operating in tropical conditions

A new agricultural tyre by Goodyear

For Mud and Slush

Goodyear in America have announced the introduction of a new agricultural tyre for use in rice and sugar-cane fields. Its principal features are the giant double-tapered lugs with deep channelled scoops between, which ensure the continuous discharge of wet soil and mud and self-cleaning at every turn of the wheel.

The new TD-7 tyre is made of specially compounded rubber reinforced with 3-T cord—tough enough to resist snagging and cutting; the giant lugs, too, are heavily reinforced to withstand abrasion and peeling.

Agricultural Chemicals

Menace of Wild Oats

The wild oat, *Avena* spp., has been recorded as a serious weed in cereals since time immemorial. It is a rigorous competitor with wheat and barley and its presence can cause appreciably reduced yields.

Careful surveys in the U.K. have revealed that over 1 million acres of cereals are affected each year. Overseas the wild oat distribution in some countries is more severe than in others, according to reports received.

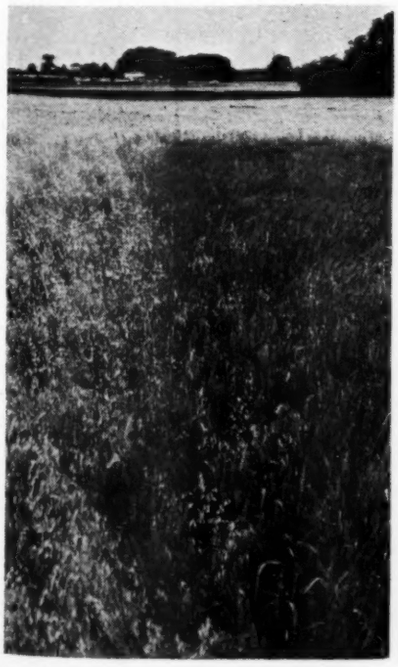
Heavy: Canada, U.S.A., Australia, Holland, Sweden, France and Germany.

Medium: Denmark, Belgium, Morocco and Spain.

Light: Norway, Finland, Greece and Cyprus.

The degree of infestation in Russia also is believed to be heavy.

Post-emergent spraying with 'Carbyne' is recommended by *Fisons Pest Control Ltd.* as an effective control for the pest. Recent experiments carried out by farmers in East Anglia have shown that the important thing is not so much its total eradication, but keeping this pernicious weed under effective control.



Norfolk. One of the farmer trials, showing the junction of the treated and untreated areas of wheat (side view)

Experiments carried out on 'dirty' fields of wheat and barley in East Anglia have shown the following remarkable comparisons for 1 sq. yd. counts:

Wheat	*Treated*	*Untreated*
No. of heads ..	254	68
Average height..	45 in.	36 in.
Wild oats		
No. of heads ..	6	178
Average height..	52 in.	60 in.

This emphasises the tremendous damage this weed can do.

'Carbyne' is a selective weedkiller which is capable of distinguishing between wild oats and the cereal crops. It is applied after the seeds have appeared and when the wild oat is between the 1½- and 2½-leaf stage, *i.e.* the first flush.

Such spraying has given average increases in yield of 4 cwt. per acre in the farmer trials and increases of 9 cwt. per acre have even been reported.

Wild Life Protection

Following the recent Government announcement banning the use of certain insecticides in seed dressings, *Plant Protection Ltd.* will sell, as from the beginning of 1962, only powder seed dressings based on gamma-BHC for the control of wireworm in cereal crops in the U.K.

Their dual-purpose dressings, based on the use of gamma-BHC (against wireworm) and organo - mercurials (against disease), are sold as 'Mergamma' and 'Ceregam'. In spite of their extensive use since 1948, these have never involved any risk to wild life; on the contrary, there is even evidence that gamma-BHC acts as a bird repellant.

The company are not introducing any liquid dressing based on gamma-BHC, as when used in adequate concentration this presents a definite hazard to the germination of the treated seed. They are also withdrawing 'Ceresol', a dual-purpose liquid containing the insecticide heptachlor, and are pinning their faith on the gamma-BHC powder dressings in the belief that these will serve the best interests of the farmer and meet with the approval of all who are concerned with the preservation of wild life in Britain.

For General Weed Control

May & Baker Ltd. offer 'Compitox' for the control of chickweed, cleavers and other weeds in cereal crops. This is a formulation of CMPP in stable, non-inflammable and non-corrosive solution which under normal conditions of use is not injurious to spray operators and domestic animals.

After dilution with water at the recommended rate of 4-6 pints in 20 gal. of water, it is applied at a spray volume of 20 gal. per acre. This can be applied even at the early growth stages of the cereal crop, when the weeds are growing most actively.

Formulations of Malathion

Malathion is an insecticide of the organo-phosphorus group which has proved of outstanding value against a wide range of common agricultural, horticultural, stored product and livestock pests. Against insects such as flies, mosquitoes and cockroaches, which in some areas have developed resistance to DDT and other chlorinated hydrocarbon insecticides, malathion achieves efficient and safe control. Malathion, unlike parathion, TEPP and most other organo-phosphorous

Norfolk. Junction of treated and untreated areas; immediate foreground treated with 'Carbyne' (front view)

insecticides, is not a deadly poison and can be used with safety, and it is claimed to be a hundred times less toxic than parathion.

Various formulations of this insecticide are offered by *S.D.C. Pesticides Ltd.* under the brand name of 'Malastan', both for home and overseas markets.

For Major Apple Pests

Baywood Chemicals Ltd. have a new chemical for British fruit growers—an insecticide which will control the three major pests of apples and pears.

'Gusathion', a discovery of *Farbenfabriken Bayer*, controls codling moth, fruit tree red spider mite, bryobia mite and tortrix caterpillars, all of which can be serious pests and which on some farms have proved difficult to check completely. Where more than one of these pests occur together they make a formidable pest complex in any orchard, but can usually be controlled by only two applications.

It is an organo-phosphorus insecticide which rapidly kills pests simply by contact with them or as a stomach poison if they feed on treated foliage or fruit. It does not act systemically and no appreciable residues are found in the fruit. This is of particular importance, since relatively late sprays are necessary against codling moth and summer tortrix. It does, however, penetrate leaf and external fruit tissue to a limited extent and will kill codling moth maggots which have entered the fruit up to three days before spraying.

Airlift to Egypt

A giant K.L.M. cargo plane loaded with agricultural chemicals—the first of 150 similar loads—left New York on 9 August for Cairo, the Egyptian Government having ordered more than 2 million lb. of 'Sevin' insecticide costing more than $2 million in order to save the cotton crop from total destruction.

The march of the army worms, *Prodenia litura*, through the cotton country has been likened to the plagues of Egypt in Biblical times. The latest reports indicate that at least one-third of the crop has already been destroyed and the estimated loss is about $25 million.

'Sevin', a new type of insecticide, is one of the carbamate series. It is of lower toxicity to man and other warm-blooded animals than are most insecticides, and this is particularly important in Egypt because most pesticides are applied there with hand-operated sprayers, and masks and protective clothing are rarely worn.

Compound Weedkillers

Whilst sodium chlorate is the most effective base for a total weedkiller, it has been found by *Chipman Chemical Co.* that its effectiveness can be increased by the addition of one or other of the new types of organic weedkillers. These are sold under such trade names as 'Atlacide' and 'Monax'.

Of the many organic weedkillers that they have tested with the chlorate, those which have the widest range of effectiveness are 'Telvar' and 'Karmex'. These are soil sterilants particularly recommended against shallow-rooted weeds. Sodium chlorate, which acts by absorption, deals with the deeper-rooted weeds and in this way the combination will usually produce a total kill.

New Compound Fertiliser

Shell Chemical Co. announce the second compound fertiliser in their range. Shell No. 2 Compound has the analysis of 21% N, 14% P_2O_5, 14% K_2O with a plant food ratio of $1\frac{1}{2} : 1 : 1$. With a high nitrogen content, it has been specially formulated for use with spring cereals. In addition, it is recommended by the manufacturers for intensive grass production as an alternative to dressings with 'Nitra-Shell', and for root crops such as sugar-beet.

The high concentration of this product makes it attractive to farmers because of the low application rates needed, which means less risk of reducing germination, less storage space required and less material to handle in the field.

Reader Service

For further information on any item reviewed in this issue please use the card provided or write to:

Reader Service,
WORLD CROPS,
Leonard Hill House,
Eden Street, London, N.W.1,
England

Nature's Own Insecticide

In its modern form *African Pyrethrum* has been made more effective by the addition of synergists. These are chemical compounds which, when added to pyrethrins, increase the toxic effect to a greater degree than the sum of the toxicities of the ingredients.

This modern pyrethrum, being non-toxic to humans, is particularly valuable for the protection of food and control of the domestic fly which is responsible for the spread of poliomyelitis, tuberculosis and bacillary dysentery. Malaria and yellow fever are spread by varieties of mosquitoes. Both flies and mosquitoes can be dealt with by P.Y.R., as it is called.

Spray Rate Calculations

The *K.E.F.* spray rate calculator is a sturdy device for relating tractor speed to the required application rate per acre and the plant or tree spacing and for determining, in less than a minute, the resulting delivery from the spray nozzles in gal. per min., with spraying to one side or to both sides. It is a circular clock, consisting of three graduated disks, mounted on a square base of rigid plastic; the scales are given in both metric and British units, and directions for use are also given in three languages—English, French and Spanish.

Manuring Rice

Green Bulletin No. 6 issued by the *Verkaufsgeminschaft Deutscher Kaliwerke*, of Germany, is entitled 'Science and Practice in the Manuring of Rice' by D. H. Glander.

It shows how there are great differences in the chemical composition and physical condition of the soils on which rice is grown and also wide differences in yield, though it does not attempt to correlate these.

It goes on to discuss the rate of nutrient removal per lb. of grain and straw in various countries and finally provides data to show the effect of potash applications, alone and compounded, and considers the results country by country.

World Crop Reports

INTERNATIONAL REPORTS

Record Rice Crop

The 1960-61 world rice crop is estimated at a record of 225 million tons of rough rice. This is 3% above the previous largest harvest of 217 million tons in 1958-59.

Weather was generally favourable in most world areas. In China, even though drought prevented any substantial production increases as occurred elsewhere in Asia, it is generally believed that the crop was maintained through increased acreage.

Other factors which have contributed to the record world production were (1) more land in rice and (2) continued improvement in cultural methods. World rice acreage—estimated at 293 million acres—was 2%, or nearly 7 million acres, more than in the previous year.

The increase in production was mainly in *Asia*. Production in North America, South America and Africa was at about the 1959-60 level. Australia's crop declined to some extent and in both Western and Eastern Europe, crops were sharply below those of the previous year.

The major importing countries of Asia had remarkable increases in production. Yields per acre were substantially higher in Japan, India, Pakistan, Malaya and Ceylon. Weather was the principal factor, but improved practices in these countries are also important in the increase in average yields per acre.

Rice crops in Asia's two major exporting countries—Burma and Thailand—were good, though yields per acre were below the exceptionally high yields of the year before. Production dropped in Vietnam and Cambodia due to unfavourable weather.

The Korean harvest declined somewhat and North Vietnam's crop is reported below the level of the previous two years, despite increased plantings.

Production in *Western Europe* declined 15%. Italy and Greece decreased their rice acreage and unfavourable weather greatly reduced average yields per acre in all countries except Greece. Acreage declined also in *Eastern Europe* and in certain countries yields were below last years.

Africa had a record rice acreage. Increased production in other countries this year offset a moderate decline in Egypt's crop. Acreage in the Congo was reported down sharply, though yields per acre were good. Malagasy Republic (Madagascar) had another very good crop.

North American harvests were up moderately except in the Caribbean. Production in Mexico continued to expand. More rice was harvested in Central America, even though Panama's production declined.

In *South America* Brazil expects a harvest as large as last year's record. British Guiana's crop greatly exceeded the previous record of 1959-60. Production increased also in Colombia, Ecuador, Surinam and Uruguay. However, it declined substantially in Argentina and Chile, and Peru's crop is reported lower than a year ago.

Gingelly

World production of sesame seed in 1960 is estimated at 1.6 million short tons, 4% less than in the previous year and 18% below the 1950-54 average. The smaller harvest was mainly due to reduced production in India and China, which nevertheless accounted for half of the world out-turn in 1960.

Production in *North America* is estimated at 168,000 tons, of which Mexico produced a record 146,000 tons. Nicaragua's harvest was two-thirds more than in the previous year. U.S. production, however, was less than half that of 1959.

In *South America* the major producers are Colombia and Venezuela. The steady growth of production in these countries during the mid-fifties has levelled off and may even decline during the next few years. Due to the lack of credits to growers, Venezuela's sesame crop was reduced last year and a further decline is forecast for 1961; the negligible increase in Colombia's output is attributed to a low support price.

Production in *Europe* and in the *U.S.S.R.* was 10% less than in 1959.

Africa produced 20% of the world total output. While Sudan accounts for about half of the regional production the combined out-turn of Nigeria, Uganda and Ethiopia is also substantial. The Nigerian crop was about 10,000 tons higher than in the previous year.

Asia is responsible for about two-thirds of the world's production. Output in 1960 was 92,000 tons less than in the previous year because of smaller crops in India and Communist China. The crop in India was badly damaged by heavy rainfall in the Andhra, Rajasthan and Madhya Pradesh and production was down an estimated 11% from a year earlier. Smaller acreage under this crop has also contributed to the smaller output, with growers more inclined to turn to oilseed crops, which are less susceptible to damage by heavy rain.

China's sesame production is thought to have declined in 1960 because of smaller acreage and possibly lower yields. The summer crop was sown late in the spring due to the later harvesting of the winter crops. Combined with wet weather in the major sesame areas in the autumn, yields probably were lower than the 1952-57 average (excluding 1954) of 360 lb. per acre.

Coffee

The first estimate of the 1961-62 world coffee crop puts total production at 75.6 million bags. This would be second only to the 1959-60 crop and would exceed the 1960-61 crop by about 20%.

The *North American* coffee crop is estimated at 9.5 million bags, compared with 8.5 million in 1961. Heavy flowering and favourable rainfall indicate a larger 1961-62 crop in Guatemala. El Salvador's crop is also expected to show increases over the 1960-61 year. Mexico's production will probably be higher in 1961-62 than in 1960-61, while Nicaragua's will show little change.

Haiti's 1961-62 crop should show a considerable improvement over the very low 1960-61 year, which was one of the smallest in history. Flowering for the 1961-62 crop in Honduras has been about normal; however, heavy rains in March reduced the 1960-61 crop somewhat.

The *South American* coffee crop in 1961-62 will be about 10 million bags above the previous year. Brazil's production, estimated at 40 million bags, is 10 million bags higher. The current crop will probably have a higher percentage of good-quality coffee than that of 1960-61.

Colombia's total 1961-62 production is estimated at 7.8 million bags, only 200,000 bags more than in the previous season. There has been considerable difficulty in harvesting the crop last year due to widespread violence in the coffee-growing areas. However, movement to market has not been reduced.

Dryness in the coastal region of Ecuador reduced the 1960-61 crop, and also caused early maturing. New trees coming into bearing will probably increase long-term production.

Africa's 1961-62 crop is expected to be slightly below 1960-61, due primarily to political disturbances in some of the important producing areas. Disturbances in Angola have curtailed the 1960-61 output and are expected to reduce the 1961-62 crop. Although the trees were heavily loaded with berries for the picking scheduled for May, a large crop so far is not being realised because of civil commotion. Weather conditions during 1960 in the Republic of the Congo contributed to a high yield in most coffee-producing regions, but again, due to political disturbances, much of the crop was left on the trees unharvested.

The 1961-62 crop for the Ivory Coast is estimated at 2.8 million bags total and 2.75 million bags exportable, slightly less than last year. As the 1960-61 season progressed the expected shortage of labour did not develop and production exceeded expectations. Some increases are expected for 1961-62 in Ethiopia, Malagasy Republic and Cameroun. Ruanda-Urundi's 1961-62 crop is also expected to exceed the 1960-61 crop, which was reduced by political disturbances.

Kenya's production continues to expand and the 1961-62 crop is estimated to be nearly 10% over 1960-61. Drought and evidence of a biannual production cycle may result in a smaller 1961-62 crop for Tanganyika. Uganda coffee production for 1961-62 is estimated at 2.2 million bags. The 1960-61 crop fell below expectations due to drought early in the year which affected both quantity and quality.

The 1961-62 crop for *Asia* and *Oceania* is estimated at 3.3 million bags. Production in India reached a record in 1960-61, but there has not been much change in Indonesia's production the past few years.

A slight increase is expected for the 1961-62 crop in the Republic of the Philippines. The size of the coffee crop in Papua and New Guinea is relatively small, but on a percentage basis production is increasing rapidly.

REGIONAL REPORTS

France

French production of *hemp* fibre decreased 59% in 1960 from 1959, thus following the recent downward trend that is expected to continue into 1961.

Hemp acreage in 1960 was officially reported at only 2,100 acres, or 44% less than the 3,760 acres in 1959, thus bringing the 1956-60 average down to 3,960. The preliminary estimate of the 1961 area is 1,730 acres. Production of fibre is officially estimated at 1.9 million lb., compared with 3.3 million in 1959 and a 1956-60 average of 4.3 million. The 1961 acreage is expected to produce about 1.6 million lb.

Uruguay

Uruguay's 1961 *sunflower* seed crop is estimated at 108,000 short tons —higher than the low output of the past two years and 15% above the 1951-60 average.

The yield per sown acre this year is expected to be slightly lower than the 1958 record, when favourable growing conditions and a minimum of plant diseases probably contributed to the large out-turn. The crops of the past two years suffered from heavy disease and insect damage, and unfavourable weather and, as a result, large portions were unharvested.

India

The 1960-61 *cotton* crop in India is currently estimated at 4.4 million bales (500 lb. gross), about one-third larger than the 3.3 million produced in the previous season and 12% above the annual average of slightly under 4 million in the past five seasons.

The larger crop may be attributed to a return to more normal yields following sharply reduced output in some areas last season. The area in cotton this season is placed at 18.7 million acres, compared with 19.2 million in 1959-60.

Pakistan

The 1960 *jute* crop in Pakistan was estimated recently at not more than 1,800 million lb., or a drop of 450 million from earlier estimates.

There has been considerable uncertainty about the size of the crop. The harvested area was reported at 1.5 million acres, or an increase of 143,000 over 1959. A proportionate rise in production would have made a crop of well over 2,350 million lb., but unfavourable weather that both reduced the crop and delayed harvest, together with some difficulty in transportation, caused considerable concern about supplies. Late in the autumn the crop was estimated at 2,250 million lb.

Canada

A preliminary estimate of Canada's 1961 grain acreage in the Prairie Provinces shows larger *wheat* and *oats* seedings than last year, but a substantial reduction for barley. Rye acreage is slightly below the small 1960 total.

Wheat acreage in the Prairie Provinces normally accounts for about 97% of Canada's wheat area. The current estimate of 23.2 million acres is 3% larger than in 1960, but is slightly below the 1950-59 average of 23.4 million. Some increase over last year is reported for each of the three provinces. Saskatchewan, the leading producer, reports 15.1 million acres, 65% of the total in the prairies.

The above figures include durum, estimated at 1.8 million acres. This figure is about double the 1960 durum acreage and 73% above the 10-year average.

The area seeded to oats for grain is 8.3 million acres, compared with 7.9 million a year ago. Barley acreage, however, shows a sharp reduction to 5.9 million acres from 7.2 million last year and the 10-year average of 8.3 million. The estimate for all rye is 429,400 acres, compared with 450,000 in 1960 and an average of 777,600 for 1950-59. This is indeed a very considerable and significant reduction.

Continued drought over a large part of the grain belt has caused crops to deteriorate. Considerable damage has also been caused by grasshoppers in some regions.

Acknowledgment is made to *For. Crops & Mark.* for much of the information contained in the above reports.